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Costs and Economies of Size in Texas-Oklahoma Cattle Feedlot Operations

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Contents

Highlights

Southern Plains (Texas and Oklahoma) feedlot operations, which are characterized by large commercial feedlots, are expected to increase in size during the next decade. Feedlots with 10,000-head-or-more capacity generally enjoyed a cost advantage over the smaller lots, especially those with less than 1,000-head capacity. Feedlots with 10,000-head-or-more capacity accounted for about 55 percent of the fed cattle marketed from Southern Plains feedlots during 1966-67, and indications are that they will account for an increasingly larger proportion of the total fed-cattle marketings.

Investments in fixed facilities varied by size of feedlot and feeding area. Total capital investments in equipment and facilities by Southern Plains feedlots averaged about $35 per head of capacity. The two largest items of capital investments, which accounted for more than one-half of the total fixed investments, were pens and associated equipment and milling equipment. Other important items of equipment were feed storage facilities, water system, feed distribution equipment, transportation equipment and land.

Annual fixed costs – depreciation, interest, taxes, insurance, repairs and fixed labor – accounted for about 5 percent of the total feeding costs. Depreciation and fixed labor represented about 60 percent of the total annual fixed costs. Interest on fixed investments and repairs made up almost another one-third of the fixed costs.

Variable costs accounted for 95 percent of the total feeding costs in the Southern Plains during 1966-67. Feed, which accounted for more than 80 percent of the total variable costs, was the most important variable cost item. Variable labor costs and interest on feeder cattle accounted for about one-half of the remaining variable costs. Death losses made up another two and one-half percent.

Feedlots with less than 5,000-head capacity were generally at a disadvantage when competing with larger feedlots with respect to annual fixed costs per pound of gain. Feedlots with a one-time feeding capacity of 1,000 head experienced total annual fixed costs equivalent to about 2.4 cents per pound of gain compared to 1.4 cents per pound of gain for feedlots with 10,000-head capacity.

One of the major contributors of lower annual fixed costs per pound of gain in the larger feedlots was the level of feedlot utilization. Feedlots with 10,000-head-and-over capacity generally exhibited utilization rates above 75 percent compared to utilization rates of 50 percent and lower for feedlots with less than 1,000-head capacity.

The competitive advantage due to size declined when feedlot utilization rates were held constant at consecutively higher levels. For example, when feedlot utilization rates were held constant at the 25-percent level, total annual fixed costs were approximately 2 cents per pound of gain higher for feedlots with 1,000-head capacity than for feedlots with 35,000-head capacity. However, differences in fixed cost between these two size groups declined to 1.2 cents per pound of gain when utilization rates were held constant at the 75-percent level.

Based on 1966-67 grain sorghum production and various assumptions regarding feed use, grain sorghum available for feeding in Texas during 1966-67 was estimated to be sufficient for finishing approximately 5 milion head of cattle or about triple the number of fed cattle marketed during that period. In addition, feeding cost differentials between feeding areas and available sources of nearby feed supplies suggest that cattle feeding will continue to be concentrated most heavily in the Texas and Oklahoma Panhandle areas.

Increased emphasis will be placed on a high degree of feedlot utilization as feedlots increase in size and are faced with increasingly larger capital investments in fixed facilities. The proportion of cattle fed on a custom basis will probably increase above 1966-67 levels when almost 60 percent in the Southern Plains were fed on a custom basis.

Numerous changes are expected to occur within the Southern Plains cattle feeding industry. These include continuing structural changes with increased emphasis on size of operation, feeding efficiency and locational advantages with regard to feed supplies. The advent of computer sciences has brought a new dimension into the feedlot industry which will broaden the horizon of management and yet provide a tool for making more detailed, timely and exacting decisions regarding feedlot operations.

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Costs and Economies of Size in Texas-Oklahoma Cattle Feedlot Operations

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Cattle feeding in Texas and Oklahoma is characterized by large and highly mechanized commercial feedlot operations. These feedlots represent one form of big business in a dynamic agricultural sector with large investments in capital equipment and resource inputs requiring both special management and labor skills. The competitive position and continued success of these large specialized firms are contingent upon efficient management decisions regarding such factors as capital expenditures, location, size of operation, type and amount of resource inputs, buying and selling practices employed, as well as many other considerations.

The recent upsurge of cattle feeding within the Southern Plains has raised numerous questions concerning economies of size in feedlot operations, the effect of location on feeding costs within the Southern Plains and the effect of the various cost components on cattle feeding operations. This study, designed to analyze these questions, represents the second phase of a comprehensive economic analysis of the cattle feeding industry within the Southern Plains. The first study was a detailed analysis of management practices and cattle feeding systems in the Southern Plains.[1]

Data were obtained through personal interviews of feedlot operators in Texas and Oklahoma. Completed questionnaires relative to feeding costs represented 70 percent of the cattle on feed in Texas and 60 percent of the cattle on feed in Oklahoma from July 1966 through June 1967.[2]

DEGREE OF FEEDLOT UTILIZATION

The recent emergence of large commercial feedlots has given rise to relatively large capital investments in fixed facilities which in turn tend to result in high levels of annual fixed costs. Rising levels of annual fixed costs have encouraged feedlot operators to maintain high levels of feedlot utilization rates which are an important index for analyzing variations in annual fixed costs among the various size feedlots in the Southern Plains.

Annual fixed costs which include such items as depreciation costs, interest, taxes, insurance, repairs and fixed labor costs are directly affected by the level of capital investment, but they are not affected by the volume or number of cattle placed on feed. Since non-feed costs remain the same regardless of the number of cattle placed on feed, increased feedlot utilization rates result in spreading such costs over greater units of output. Output can be measured by annual number of fed cattle marketed or annual pounds of gain.

Utilization of feedlot facilities has been measured primarily by the "turnover ratio" or the annual number of cattle fed divided by the one-time feedlot capacity.[3] However, when annual feedlot operations are analyzed, the turnover ratio does not appear to be an accurate indicator of utilization rate since it does not directly consider length of feeding period. The degree of feedlot utilization rate developed for this study was as follows:

$$\text{Degree of feedlot utilization} = \frac{(\text{Turnover Ratio})\ (\text{Average Days on Feed})}{365}$$

This measurement of annual utilization rate allows for variations in feeding programs among the various

[1]Dietrich, R. A., The Texas-Oklahoma Cattle Feeding Industry—Structure and Operational Characteristics, B-1079, Texas Agr. Exp. Sta., Texas A&M University, College Station, Texas, December 1968.

[2]See Dietrich, R. A., The Texas-Oklahoma Cattle Feeding Industry, for a detailed description of the sampling procedure employed.

[3]Hopkins, J. A. and R. C. Kramer, Cattle Feeding in California, Bank of America NT & SA, Economic Research Department, February 1965; Hunter, E. C. and J. P. Madden, Economies of Size for Specialized Beef Feedlots in Colorado, Agricultural Economic Report 91, ERS, USDA, May 1966; Malone, J. W. and L. E. Rogers, Economies of Size of Warmup Cattle Feedlot Operations in Nevada, B-6, Max C. Fleischmann College of Agriculture, University of Nevada, November 1965.

Table 1. Degree of feedlot utilization, by size of feedlot, Texas and Oklahoma, 1966-67 1/

State	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	-Percent-					
Texas	41.4	51.8	66.5	68.2	77.6	73.0
Oklahoma	24.3	36.2	61.1	64.3	78.6	69.1

1/ Based on 100-percent utilization of available capacity for 365 days.

sizes and types of feedlot operations and provides for a uniform measure of feedlot utilization rate.

The degree of feedlot utilization varied more by size of feedlot than by feeding areas in the Southern Plains during 1966-67, Tables 1, 2 and 3. The utilization rate varied from a high of almost 80 percent for feedlots with 10,000-head-and-over capacity to about 25 percent for the small farmer-feeder type of operation. There was less variation in utilization rate among feeding areas than among size groups since each feeding area also contained some of the larger type feeding operations. Delineations of Texas and Oklahoma feeding areas are indicated in Figures 1 and 2.

INVESTMENT IN EQUIPMENT AND FACILITIES

Total capital investments in equipment and facilities by Texas and Oklahoma feedlots averaged about $35 per head of capacity during 1966-67, Tables 4 and 5.[4] Per head of capacity in this study refers to

[4]Capital investments represent the original cost of equipment and facilities. These costs were not adjusted for differences in age of equipment since two-thirds or more of the feedlots were established during or after 1960.

Table 2. Degree of feedlot utilization, by feeding area, Texas feedlots, 1966-67 1/

Item	Feeding area				
	Panhandle-Plains	Plateau-Pecos	East Texas	Gulf Coast and Rio Grande Plains	Total
	-Percent-				
Degree of utilization	78.5	54.2	72.9	65.4	73.0

1/ Based on 100-percent utilization of available capacity for 365 days.

Table 3. Degree of feedlot utilization, by feeding area, Oklahoma feedlots, 1966-67 1/

Item	Feeding area				
	Panhandle	Northern Oklahoma	Southeastern and Central Oklahoma	Southwestern Oklahoma	Total
	-Percent-				
Degree of utilization	77.5	44.4	59.3	69.7	69.1

1/ Based on 100-percent utilization of available capacity for 365 days.

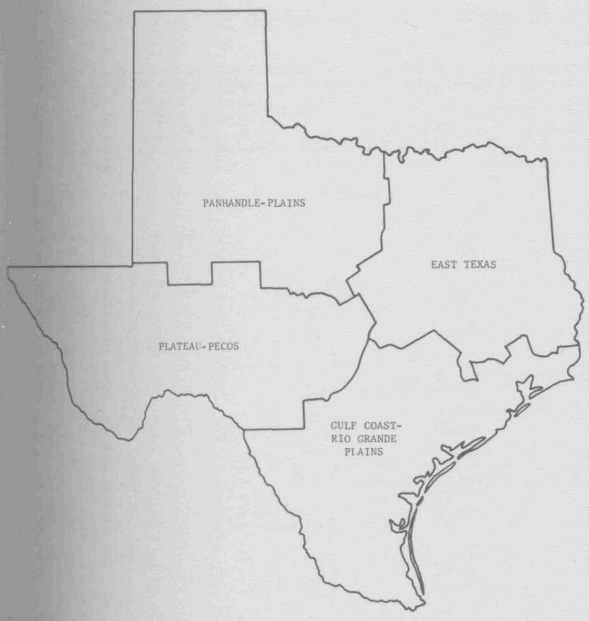


Figure 1. Texas cattle feeding areas.

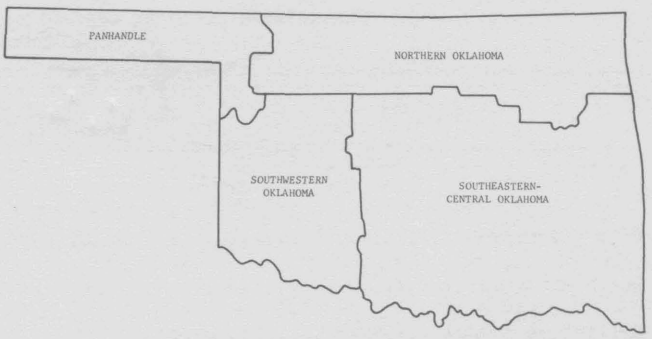


Figure 2. Oklahoma cattle feeding areas.

the one-time feeding capacity. The two largest items of capital investments, which accounted for more than one-half of the total fixed investments, were pens plus associated equipment and milling equipment. Investments in pens and equipment averaged about $11 per head of capacity compared to more than $8 per head for milling equipment. Feed storage facilities and equipment represented the third largest item of capital investment in both Texas and Oklahoma.

The patterns of total fixed investments among various size groups of feedlots in both Texas and Oklahoma were fairly similar. Total fixed investments were lowest for feedlots in the 5,000 - 9,999-head capacity size ranges in both Texas and Oklahoma, followed by feedlots with 10,000-head-and-over capacity in Texas. Fixed investments were highest for feedlots in the 1,000 - 1,999 size group. Farmer-feeders – feedlots with less than 1,000-head capacity – ranked third in total investments on a per-head capacity basis in Texas. Farmer-feeders in the Southern Plains often

Table 4. Fixed investments per head of capacity, by major items of equipment and size of feedlots, Texas feedlots, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Pens & equipment 1/	7.31	10.84	15.37	10.05	9.86	10.72
Water system	2.40	2.65	2.12	1.58	2.35	2.20
Milling equipment 2/	3.95	7.62	8.74	8.14	8.60	8.45
Feed storage facilities & equipment 3/	16.60	12.26	8.78	2.77	5.37	5.81
Feed distribution equipment 4/	5.25	3.81	3.25	2.02	1.71	2.10
Manure equipment	.52	1.84	1.22	.47	.38	.56
Transportation equipment	3.43	4.92	1.99	1.36	1.04	1.36
Land	2.81	3.13	3.11	3.04	2.15	2.47
Office & office equipment	.19	.61	.77	1.02	.68	.74
Scale & scale house	.87	2.04	1.46	1.20	.62	.88
Total	43.33	49.72	46.81	31.65	32.76	35.29

1/ Feeding pens, work pens and chute, hospital pens, feed trough and bunks and self feeders.
2/ Hammermill, roller, crimper, steam generator, feed mixer, molasses mixer, scales etc.
3/ Silo, elevator, silage loader, tractor-power scoop and loader etc.
4/ Mechanical (auger-tube), auger-unloading bulk feed trucks, front end loader, auger-mixer grain wagon, farm tractor, utility wagon, hand scoops etc.
NOTE: These footnotes are applicable for all tables containing the above listed major items of equipment.

Table 5. Fixed investment per head of capacity, by major item of equipment and size of feedlot, Oklahoma feedlots, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
			-Dollars-			
Pens & equipment	6.02	13.86	9.26	11.71	11.50	11.25
Water system	1.63	2.49	1.53	1.83	2.57	2.20
Milling equipment	1.31	3.66	8.07	3.02	11.25	8.16
Feed storage facilities & equipment	7.84	10.56	6.31	2.64	4.76	4.98
Feed distribution equipment	4.05	3.59	4.22	2.91	3.33	3.41
Manure equipment	.94	.75	.18	1.55	.92	.92
Transportation equipment	5.42	2.34	2.88	1.78	.78	1.54
Land	5.17	3.73	1.12	.92	1.08	1.29
Office & office equipment	.06	.16	1.07	.80	.75	.77
Scale & scale house	.06	1.51	1.35	1.87	.95	1.25
Total	32.50	42.65	35.99	29.03	37.89	35.77

use vacant pen space or build their own pens and facilities from less costly materials than those used by the larger feedlots. Many farmer-feeders are also able to use their own hammermill and grinder or acquire such equipment at less cost per head of capacity than are larger feedlot owners with the more sophisticated milling equipment.

Investment in milling equipment on a per-head-of-capacity basis generally increased as feedlots increased in size. The larger, highly commercialized feedlots generally used more refined and more precise milling equipment which was relatively more expensive than that employed by the smaller feedlots. These larger feedlots, however, offset such higher investment costs by using existing facilities at higher levels of intensity than did the smaller feedlots. Investments in feed storage facilities and equipment, feed distribution equipment and transportation equipment were generally lower in the larger feedlots on a per-head-of-capacity basis. The smaller feedlots often produce much of their own feed which is stored for feeding at a later date. Consequently, feedlots with 2,000-head-or-less capacity often exhibited relatively higher investments in feed storage facilities than did lots with more than 2,000-head capacity. In contrast, many of the feedlots with 5,000-head-and-over capacity maintained grain storage facilities necessary for holding feed supplies for approximately 2 weeks or less for feeding at full capacity. Although many of the farmer-feeders did not maintain an office or own scales, such equipment was considered essential by the larger feedlots.

The level of capital investments varied more among feeding areas in the Southern Plains than by size of feedlot, Appendix A, Tables 1 and 2. Total capital investments among feeding areas in Oklahoma ranged from $26 to $44 per head of capacity, and from $28 to $40 per head of capacity in Texas. Feedlots in Northern Oklahoma and the Plateau-Pecos area of Texas, which exhibited lower fixed cost per head of capacity, were relatively small and generally older than in most other areas of the Southern Plains. Highest levels of investments occurred in the Texas Gulf Coast-Rio Grande Plains and in the Southeastern-Central Oklahoma feeding areas. Both of these areas are subject to higher levels of rainfall than other feeding areas and generally incurred relatively higher levels of investments in feed storage facilities and land.

ANNUAL FIXED COSTS

Annual fixed costs in this study include depreciation, interest, taxes, insurance, repairs and labor costs. The most important items of fixed costs were depreciation costs and fixed labor which accounted for about 60 percent of the total fixed costs, Table 6. Interest on fixed investment and repairs, which made up 32 percent of the fixed costs, ranked second in importance. Taxes and insurance accounted for the remaining annual fixed costs. It should be noted that all costs in this study which are quoted on the basis of *pound of gain are net market weights* unless otherwise indicated.[5]

[5]Net market weight assumes a 4-percent shrink at the feedlot.

Table 6. Annual fixed costs per pound of gain, by size of feedlot, Texas and Oklahoma, 1966-67

State and item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Texas:						
Depreciation	.0081	.0078	.0057	.0036	.0030	.0036
Interest	.0043	.0039	.0030	.0020	.0017	.0019
Taxes	.0010	.0009	.0007	.0005	.0004	.0005
Insurance	.0009	.0008	.0005	.0003	.0003	.0003
Repairs	.0025	.0015	.0023	.0023	.0017	.0018
Labor	.0101	.0049	.0072	.0049	.0027	.0037
Total	.0269	.0198	.0194	.0136	.0098	.0118
Oklahoma:						
Depreciation	.0112	.0090	.0054	.0036	.0042	.0044
Interest	.0060	.0051	.0024	.0017	.0020	.0021
Taxes	.0015	.0014	.0007	.0005	.0006	.0006
Insurance	.0012	.0010	.0006	.0003	.0004	.0005
Repairs	.0029	.0018	.0031	.0028	.0026	.0027
Labor	.0119	.0068	.0082	.0052	.0030	.0044
Total	.0347	.0251	.0204	.0141	.0128	.0147

Each of the depreciable major items of equipment was assigned an expected life and salvage value (percent of the original cost) and amortized over this useful life as shown in Appendix B. Depreciation costs ranged from .3 cent per pound of gain for feedlots with 10,000-head-and-over capacity to more than 1 cent per pound of gain for farmer-feeders, Table 6. Much of the lower depreciation costs per pound of gain for the larger feedlots is the result of higher levels of feedlot utilization rates compared to those of the smaller feedlots. The major items of depreciation costs, which accounted for more than 70 percent of the total depreciation costs, were milling equipment, pens and equipment, and feed distribution equipment, Appendix A, Tables 3 and 4. Depreciation costs also varied considerably among feeding areas, Appendix A, Tables 5 and 6. Depreciation costs, per pound of gain, were generally lowest in those areas where large, commercial feedlots predominate.

With increasingly larger feedlot operations in the Southern Plains, it was assumed in this study that larger proportions of the available labor force become fixed as the feedlots increase in size. That is, a certain proportion of the labor force is essential for administrative purposes regardless of the number of cattle placed on feed. Labor was, therefore, classified as fixed or variable, by size of feedlot, as indicated in Appendix B. The labor force in Southern Plains feedlots included some or all of the following personnel: operator or manager, yard foreman, assistant yard foreman, mill foreman, mill men, feeders, cowboys, office manager, secretary or clerk and miscellaneous labor.

Fixed labor costs, per pound of gain, were lowest in the Southern Plains for feedlots with 10,000-head-and-over capacity, Table 6. They were highest for feedlots with less than 1,000-head capacity and generally declined as feedlots increased in size. When fixed costs were based on per head of capacity, labor costs were highest for feedlots in the 2,000 - 4,999-size group, Table 7. Differences in fixed labor costs among feedlots can be partially offset with higher degrees of feedlot utilization rates.

Annual interest on capital investment on a per-head-of-capacity basis was generally as high or higher for feedlots with 10,000-head-or-more capacity as for any other size group, Table 7.[6] However, when interest on fixed investments is analyzed on the basis of pound of gain, feedlots with 10,000-head-and-over capacity, as well as those with more than 5,000-head feeding capacity, exhibited lower interest costs than did other size groups, Table 6. These lower costs by the larger feedlots, again, were partially due to higher feedlot utilization rates. Annual interest costs for major items of equipment are indicated in Appendix A, Tables 7 and 8.

Annual repair and maintenance costs, which were estimated by feedlot operators, contain some elements of variable costs since most respondents were generally unable to allocate repair costs between fixed or variable costs. Feedlots with 10,000-head-and-over capacity were generally faced with higher repair costs than other size groups when analyzed on the basis of per head of capacity, Table 7. Although repair costs and intensity of feedlot use are highly correlated, differences in repair costs among size groups appear to be

[6] Annual interest cost on fixed investment was computed, by major items of equipment, as follows:

$$\text{Long Term Interest} = \frac{(\text{Original Cost} + \text{Salvage Value})\ (.06)}{2}$$

where .06 = the long term interest rate. Interest cost on land was defined as original land cost × .06.

Table 7. Annual fixed costs per head of capacity, by size of feedlot, Texas and Oklahoma, 1966-67

State and item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
			-Dollars-			
Texas:						
Depreciation	3.0003	3.5663	3.1873	2.1609	2.1861	2.3808
Interest	1.5863	1.8071	1.7027	1.1709	1.1894	1.2858
Taxes	.3684	.4228	.4005	.2690	.2795	.3011
Insurance	.3545	.3807	.3048	.1951	.2130	.2304
Repairs	.9291	.6883	1.2658	1.4001	1.1988	1.2259
Labor	3.7610	2.2527	4.0398	2.9292	1.9340	2.4577
Total	9.9996	9.1179	10.9009	8.1252	7.0008	7.8817
Oklahoma:						
Depreciation	2.3597	2.7582	2.7759	2.2172	2.8440	2.6766
Interest	1.2587	1.5776	1.2776	1.0231	1.3365	1.2702
Taxes	.3237	.4266	.3598	.2902	.3789	.3579
Insurance	.2550	.2932	.3130	.1893	.2956	.2735
Repairs	.6169	.5485	1.6022	1.6946	1.8025	1.6407
Labor	2.5325	2.1107	4.2098	3.1938	2.0444	2.6885
Total	7.3465	7.7148	10.5383	8.6082	8.7019	8.9074

associated to a smaller extent with the degree of feedlot utilization rates than were most other fixed-costs items, Table 6. The practice of replacing with rapidly changing technological innovations the feeding and milling equipment impaired by obsolescence and exposure to elements may be as important as degree of feedlot utilization with respect to repair costs.

Taxes on total fixed investments generally vary by state and among regions within a state.[7] Taxes on fixed investments accounted for about 4 percent of the total annual fixed costs in the Southern Plains during 1966-67. Taxes were considerably lower for feedlots with 5,000-head-and-over capacity than for smaller feedlots when analyzed on the basis of pounds of gain, Table 6. Taxes by size of feedlot, however, vary to a smaller degree when analyzed on the basis of capacity, Table 7.

Although much of the equipment in numerous feedlots was not insured, the owner assumes an implicit risk associated with owning and operating various items of equipment.[8] Insurance costs on fixed investments averaged about 25 cents per head of capacity within the Southern Plains, Table 7. In terms of total fixed costs, insurance costs are relatively minor since they account for about 3 percent of the annual fixed costs. Insurance costs averaged about .04 cent per pound of gain in Texas and Oklahoma during 1966-67. Since the feedlot utilization rates were approximately three times higher in the large feedlots than in the small lots, insurance costs per pound of gain were also about three times higher in the small feedlots.

[7]Annual taxes on fixed investments were computed at the rate of .85 percent for the total feedlot fixed assets in Texas and 1.0 percent in Oklahoma.

[8]On the basis of informtion from insurance agents, Texas feedlots were assessed an insurance charge equal to 1.15 percent of the total value of milling equipment, feed storage facilities and equipment, feed distribution equipment, manure equipment, transportation equipment, office and office equipment and scales. Oklahoma feedlots were assessed an insurance charge of 1.30 percent for these same items.

VARIABLE COSTS

Variable costs are those which vary with output or the volume of cattle placed on feed. The major items of variable costs for Southern Plains feeders were feed, interest on feeder cattle, labor, death loss and veterinarian costs. Fuel, power and communication expenses accounted for smaller proportions of the total variable costs.

Total variable costs in Oklahoma were lowest for feedlots with 5,000-head-and-over capacity, Table 8. Although total variable costs did not differ markedly among size groups in Texas during 1966-67, feedlots with 10,000-head-and-over capacity exhibited lower variable feeding costs than did other size groups, Table 9.

Feed costs per pound of gain, which accounted for more than 80 percent of the total variable feeding costs, varied by size of feedlot, Tables 8 and 9, and by feeding area, Appendix A, Tables 9 and 10. However, the relative importance of feed as a variable cost item is affected by the *annual price level* of the major feed ingredients. Feed costs per pound of gain are also affected by such factors as location, type of cattle placed on feed and feeding practices employed. For example, Texas feedlots generally placed cattle on feed at lower weights than did feeders in Oklahoma. This practice generally contributed to slightly lower feeding costs in Texas feedlots. Numerous feedlot operators stated that placements at lighter weights often result in higher feed conversion rates as a result of additional growth as well as weight gains through the fattening process. Feed conversion rates, by size of feedlot and type of feed, are shown in Table 10.

Table 8. Variable costs per pound of gain, by size of feedlot, Oklahoma, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Feed	.1974	.1999	.1922	.1880	.1851	.1873
Labor 1/	.0129	.0187	.0164	.0079	.0096	.0106
Interest:						
Feed	.0054	.0059	.0056	.0055	.0054	.0055
Feeder cattle	.0128	.0137	.0147	.0130	.0162	.0151
Labor	.0004	.0006	.0005	.0002	.0003	.0003
Other 2/	.0003	.0003	.0003	.0002	.0002	.0002
Death loss	.0028	.0085	.0081	.0059	.0064	.0066
Veterinarian and medication	.0048	.0065	.0048	.0033	.0035	.0038
Gas and oil	.0031	.0027	.0024	.0018	.0008	.0013
Electricity	.0006	.0014	.0016	.0008	.0011	.0011
Telephone and communications	.0006	.0005	.0013	.0007	.0003	.0005
Other 3/	.0010	.0005	.0006	.0004	.0006	.0005
Total	.2421	.2592	.2485	.2277	.2295	.2328

1/ Includes assessments for Social Security and Workman's Compensation.

2/ Interest charges for operating capital for five months. This does not include interest charges for feed, cattle and labor.

3/ Includes charges for office supplies, consultant fees, liability insurance, taxes on cattle and miscellaneous expenditures.

The daily volume of feed consumed in Southern Plains feedlots, on a dry weight basis, averaged more than 21 pounds per head during 1966-67, Tables 11, 12 and 13. Grain sorghum was the predominant type of feed or concentrate fed. Daily feed consumption rates were generally highest for those feedlots feeding the highest proportion of roughage items. Daily feeding rates are also affected by the size of feeder cattle. For example, placements in the Texas Gulf Coast and Rio Grande Plains feedlots averaged under 400 pounds during 1966-67. The daily feed consumption in these areas averaged less than 18 pounds per

Table 9. Variable costs per pound of gain, by size of feedlot, Texas 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Feed	.1689	.1755	.1791	.1818	.1764	.1775
Labor 1/	.0149	.0130	.0096	.0084	.0074	.0080
Interest:						
Feed	.0050	.0051	.0053	.0053	.0052	.0052
Feeder cattle	.0114	.0109	.0119	.0119	.0121	.0120
Labor	.0004	.0004	.0003	.0003	.0002	.0002
Other 2/	.0003	.0005	.0003	.0003	.0002	.0002
Death loss	.0059	.0063	.0068	.0051	.0049	.0052
Veterinarian and medication	.0044	.0035	.0057	.0044	.0044	.0046
Gas and oil	.0022	.0017	.0015	.0015	.0009	.0011
Electricity	.0014	.0012	.0014	.0010	.0009	.0010
Telephone and communications	.0009	.0004	.0007	.0004	.0003	.0004
Other 3/	.0004	.0003	.0017	.0014	.0008	.0010
Total	.2161	.2188	.2243	.2218	.2137	.2164

1/ Includes assessments for Social Security and Workman's Compensation.

2/ Interest charges for operating capital for five months. This does not include interest charges for feed, cattle and labor.

3/ Includes charges for office supplies, consultant fees, liability insurance, taxes on cattle and miscellaneous expenditures.

Table 10. Volume of feed per pound of gain, by type of feed and size of feedlot, Texas and Oklahoma feedlots, 1966-67 1/

State and type of feed	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Pounds					
Texas:						
Concentrates:						
Grain sorghum	5.62	5.91	5.89	6.01	5.30	5.50
Barley & corn	.29	.08	.08	.07	.14	.12
Pre-mix	.39	.59	.59	.46	.46	.48
Molasses	.08	2/	.17	.23	.32	.28
Fat	3/	2/	.05	.10	.19	.15
Other concentrates	.26	.19	.14	.23	.14	.16
Total	6.64	6.77	6.92	7.10	6.55	6.69
Roughage:						
Silage 4/	.95	1.03	.46	.48	.34	.39
Cottonseed hulls	.20	.34	.50	.35	.59	.54
Other roughage 4/	.69	.20	.53	.73	.87	.79
Total	1.84	1.57	1.49	1.56	1.80	1.72
Total	8.48	8.34	8.41	8.66	8.35	8.41
Oklahoma:						
Concentrates:						
Grain sorghum	5.01	3.28	6.39	4.85	6.11	5.75
Barley & corn	1.18	2.66	1.24	1.41	.02	.61
Pre-mix	.73	.73	.61	.50	.54	.55
Molasses	.03	.19	.13	.24	.50	.37
Fat	2/	.05	.04	.05	.06	.05
Other concentrates	.03	.04	.13	.10	.08	.09
Total	6.98	6.95	8.54	7.15	7.31	7.42
Roughage:						
Silage 4/	.40	.82	.22	.58	.93	.74
Cottonseed hulls	.13	.64	.39	.32	.17	.25
Other roughage 4/	.95	1.33	.63	1.02	.44	.64
Total	1.48	2.79	1.24	1.92	1.54	1.63
Total	8.46	9.74	9.78	9.07	8.85	9.05

1/ Assuming net market weights for fed cattle.
2/ Less than .005 pounds.
3/ None reported by respondents interviewed.
4/ Silage and green chop weights were adjusted to a dry weight basis by dividing by 3.

head or more than 3 pounds under the average consumption rates in Texas, Table 12.

Total short-term interest costs made up from 8 to 9 percent of the total variable feeding costs in Southern Plains feedlots. Interest on feeder cattle alone accounted for about 70 percent of the total short-term interest costs or about 6 percent of the total variable costs.[9] Interest on feed accounted for most of the remaining short-term interest cost.[10] Interest on operating capital for labor and other variable cost items was relatively minor.

Labor, which was the third most important variable cost item, represented about 4 percent of the total variable feeding costs. Variable labor costs in both Texas and Oklahoma were generally lowest for feedlots with 5,000-head-and-over capacity. Lower labor costs in the larger lots are partially attributable to higher degrees of labor specialization and more intensive use of mechanized equipment. Smaller feedlots generally use less specialized power equipment than do large feedlots, and individual assignments in small lots often include a variety of jobs in contrast to the more specialized labor structure in the larger feedlots.

Death losses, which averaged about 1.1 percent in Texas and Oklahoma, accounted for about two and one-half percent of the total variable costs. Death losses generally vary among feedlots depending upon size of feedlot, location, weather conditions and size of feeder animal placed on feed. Many feedlot operators stated that inclement and especially rainy weather

[9] Interest charges on feeder cattle = (Feeder Cattle Cost) (.416667) (.07) where: .416667 represents interest charges for a 5-month period and .07 represents the short-term interest charge. Feeder cattle costs were computed as

(1) Average Price Per Pound
= [($.2640) (Percent Steers)+($.2343) (Percent Heifers)]

(2) Price Per Head
= (Average Price Per Pound) (Average Placement Weight)

(3) Feeder Cattle Cost
= (Average Price Per Head) (Numbers Placed on Feed)

[10] Short-term interest charges for feed, labor or operating capital for other variable cost items = (Total Cost) (.416667) (.07).

Table 11. Volume of feed per head per day, by type of feed and size of feedlot, Texas and Oklahoma feedlots, 1966-67

State and type of feed	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
			-Pounds-			
Texas:						
Concentrates:						
Grain sorghum	14.0	14.4	13.7	14.5	13.6	13.8
Barley & corn	.7	.2	.2	.2	.4	.3
Pre-mix	1.0	1.4	1.4	1.1	1.2	1.2
Molasses	.2	1/	.4	.6	.8	.7
Fat	2/	2/	.1	.2	.5	.4
Other concentrates	.6	.5	.3	.6	.4	.4
Total	16.5	16.5	16.1	17.2	16.9	16.8
Roughage:						
Silage 3/	2.4	2.5	1.1	1.2	.9	1.0
Cottonseed hulls	.5	.8	1.2	.8	1.5	1.3
Other roughage 3/	1.7	.5	1.2	1.8	2.2	2.0
Total	4.6	3.8	3.5	3.8	4.6	4.3
Total	21.1	20.3	19.6	21.0	21.5	21.1
Oklahoma:						
Concentrates:						
Grain sorghum	12.2	7.7	14.7	12.8	14.6	14.0
Barley & corn	2.9	6.3	2.8	3.7	.1	1.5
Pre-mix	1.8	1.7	1.4	1.3	1.3	1.3
Molasses	.1	.5	.3	.6	1.2	.9
Fat	2/	.1	.1	.1	.1	.1
Other concentrates	.1	.1	.3	.3	.2	.2
Total	17.1	16.4	19.6	18.8	17.5	18.0
Roughage:						
Silage 3/	1.0	1.9	.5	1.5	2.2	1.8
Cottonseed hulls	.3	1.5	.9	.9	.4	.6
Other roughage 3/	2.3	3.1	1.5	2.7	1.1	1.5
Total	3.6	6.5	2.9	5.1	3.7	3.9
Total	20.7	22.9	22.5	23.9	21.2	21.9

1/ Less than .05 pound.
2/ None reported by feedlots interviewed.
3/ Silage and green chop weights were adjusted to a dry weight basis by dividing by 3.

conditions tend to increase death losses. In the Southern Plains death losses were generally lower in feedlots with 5,000-head-and-over capacity compared to feedlots with less than 5,000-head capacity. Several factors tend to contribute to this pattern. The large feedlots are located primarily in the Texas and Oklahoma Panhandle areas where climatic conditons are considered relatively favorable for cattle feeding. Also, larger feedlots often retain personnel such as trained veterinarians or practical veterinarians who are capable of providing immediate medication and other necessary aid. In addition, feedlots with 10,000-head-and-over capacity generally placed cattle on feed at relatively heavier weights than did smaller feedlots. Heavier and more mature feeder cattle are often less susceptible to disease and sickness than are lighter weight feeder cattle.

Veterinarian and medication costs represented about 2 percent of the total variable costs during 1966-67. It is interesting to note that veterinarian and medication expenses were not necessarily higher for those size groups which also had relatively higher death losses.

Gas and oil, as well as electricity, accounted for less than 1 percent of the total variable feeding costs in the Southern Plains. Gas and oil expenditures were relatively lower for the large feedlots in both Texas and Oklahoma during 1966-67. Other items of variable costs included telephone and communications as well as office supplies, consultant fees and other miscellaneous expenditures.

TOTAL FEEDING COST

Variable costs — those costs directly affected by daily management decisions and volume — accounted for 95 percent of the total feeding costs in the Southern Plains during 1966-67, Table 14. The proportion of total costs accounted for by variable costs in Texas ranged from 96 percent for feedlots with 10,000-head-and-over capacity to 89 percent for feedlots with less than 1,000-head capacity. In Oklahoma, the proportion of total costs represented by variable costs ranged from 95 percent for the larger feedlots to 87 percent for the farmer-feeder operations. The proportion of total feeding costs represented by variable costs also varied by feeding areas, Appendix A, Tables 11 and

Table 12. Volume of feed per head per day, by type of feed, and feeding area, Texas feedlots, 1966-67

Type of feed	Feeding area				
	Panhandle-Plains	Plateau-Pecos	East Texas	Gulf Coast and Rio Grande Plains	Total
	Pounds				
Concentrates:					
Grain sorghum	14.6	11.5	12.3	12.2	13.8
Barley and corn	.2	1.0	1.0	1/	.3
Pre-mix	1.2	.9	.9	1.5	1.2
Molasses	.7	1.2	.7	.4	.7
Fat	.4	.3	.5	.2	.4
Other concentrates	.4	.7	.5	.3	.4
Total	17.5	15.6	15.9	14.6	16.8
Roughage:					
Silage 2/	.9	1.3	.4	1.6	1.0
Cottonseed hulls	1.6	1.4	1.2	.5	1.3
Other roughage 2/	2.2	1.8	2.5	1.0	2.0
Total	4.7	4.5	4.1	3.1	4.3
Total	22.2	20.1	20.0	17.7	21.1

1/ Less than .05 pound.

2/ Silage and green chop weights were adjusted to a dry weight basis by dividing by 3.

Table 13. Volume of feed per head per day, by type of feed and feeding area, Oklahoma, 1966-67

Type of feed	Feeding area				
	Panhandle	Northern Oklahoma	Southeastern and Central Oklahoma	Southwestern Oklahoma	Total
	Pounds				
Concentrates:					
Grain sorghum	15.0	6.6	13.0	14.7	14.0
Barley & corn	.4	9.3	1.2	2.0	1.5
Pre-mix	1.4	2.0	.6	1.6	1.3
Molasses	1.3	.1	.8	.1	.9
Fat	.1	1/	.2	.3	.1
Other concentrates	.1	.1	.9	.2	.2
Total	18.3	18.1	16.7	18.9	18.0
Roughage:					
Silage 2/	2.7	1.5	.6	.2	1.8
Cottonseed hulls	.2	1.6	1.4	.7	.6
Other roughage 2/	1.4	2.8	2.0	1.2	1.5
Total	4.3	5.9	4.0	2.1	3.9
Total	22.6	24.0	20.7	21.0	21.9

1/ Less than .05 pound.

2/ Silage and green chop weights were adjusted to a dry weight basis by dividing by 3.

Table 14. Total feeding costs per pound of gain, by type of cost and size of feedlot, Texas and Oklahoma, 1966-67

State and type of cost	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Texas:						
Fixed	.0269	.0198	.0194	.0136	.0098	.0118
Variable	.2161	.2188	.2243	.2218	.2137	.2164
Total	.2430	.2386	.2437	.2354	.2235	.2282
Oklahoma:						
Fixed	.0347	.0251	.0204	.0141	.0128	.0147
Variable	.2421	.2592	.2485	.2277	.2295	.2328
Total	.2768	.2843	.2689	.2418	.2423	.2475

12. Smaller feedlots generally exhibited higher proportions of fixed costs than did the larger feedlots because of lower feedlot utilization rates.

Total feeding costs were slightly higher and more varied among feedlots during 1966-67 in Oklahoma than was generally true for Texas feedlots. Feedlots in Oklahoma generally placed a heavier type of feeder animal on feed than did Texas feedlots. Heavier feeder animals often represent higher investment costs, higher interest costs, lower feed conversion rates and higher daily feed consumption rates. However, heavier weight feeder cattle often finish out at relatively higher grades and often also command a higher price in the market than do lighter weight feeder cattle.

Feeding costs, as shown in Table 14, are generally higher than those acknowledged by many of the feedlots interviewed – primarily the smaller feedlots. The smaller feedlots, especially farmer-feeders, often are not assessing charges for such items as depreciation, interest on fixed investments and variable cost items, insurance and labor costs. Such cost items, regardless of source, represent inputs to the feeding enterprise and contribute to total feeding costs. In addition, assessments for such items as interest on feeder cattle and death losses were generally not borne by the custom feeder. Hence, charges for such items are not included in feeding costs assessed by the custom feeder.

The Texas Panhandle-Plains area and the Oklahoma Panhandle are the two most important custom feeding areas within the Southern Plains. Elimination of assessments for interest on feeder cattle and death losses, for example, decreased feeding costs to the custom operator in the Texas Panhandle-Plains area by $0.0169, per pound of gain, as compared to $0.0174 for the custom operator in the Oklahoma Panhandle during 1966-67, Table 15.

Table 15. Feeding costs, per pound of gain, of custom feedlot operators in selected feeding areas, Texas and Oklahoma, 1966-67 1/

Item	Texas Panhandle-Plains	Oklahoma Panhandle
	Dollars	
Total variable cost	.2167	.2227
Less:		
Interest on feeder cattle	.0120	.0125
Death loss	.0049	.0049
Total non-custom	.0169	.0174
Adjusted variable cost	.1998	.2053
Total fixed cost	.0105	.0130
Total custom feeding cost	.2103	.2183

1/ See Appendix A, Tables 9, 10, 11 and 12. Custom feeding costs in the above table do not reflect a mark-up for profit.

BREAKEVEN ANALYSIS

Cattlemen and feedlot operators often express concern about breakeven prices and especially negative fat cattle price margins. Various authorities in the livestock industry and especially in the feeding industry often lament the economic plight of cattle feeding when negative price margins prevail. However, profit margins can be and often are favorable when fat cattle prices are below feeder cattle prices, depending upon feeding costs per pound of gain.

Tables 16, 17 and 18 show breakeven prices at various combinations of feeder cattle prices and feeding costs per pound of gain for a 500-pound feeder animal under assumptions of a 250, 300 and 350-pound net gain, respectively.[11] The data in Table 16 indicate that it is profitable to feed a 500-pound feeder animal costing $28 per hundredweight and selling for $26 per hundredweight when feeding costs do not exceed 22 cents per pound of gain. On the other hand, if this same feeder animal had cost $30 per hundredweight and total feeding costs for a 250-pound net gain were 22 cents per pound, then the breakeven price would be $27.33. The data in Table 16 also show that the breakeven price increases about 33 cents per hundredweight for each 1-cent increase in total feeding cost for a 500-pound feeder animal with a 250-pound net gain. In contrast, the breakeven price for a 500-pound feeder animal with a 350-pound net gain increases 41 cents per hundredweight for each 1-cent increase in total feeding costs, Table 18.

These tables also show that increased net pounds of gain at the same feeding costs result in lower breakeven prices provided costs per pound of gain do not exceed the purchase price of the feeder animal. For example, assume a 500-pound feeder animal was laid-in at the feedlot at $28 per hundredweight. According to Tables 16 and 17, the breakeven price for this animal would have been 25 cents per hundredweight lower for a 300-pound net gain than for a 250-pound net gain, assuming a total feeding cost of 22 cents per pound of gain. A 350-pound net gain for this same animal would have resulted in a breakeven price

[11] Breakeven price = $\frac{\text{(Purchase Price) (Weight of Feeder Animal)} + \text{(Net Pounds of Gain) (Feeding Cost/Pound)}}{\text{Net Sale Weight}}$

Breakeven tables were also developed for 400, 600, 700 and 800-pound feeder animals.

Table 16. Schedule of breakeven prices for a 500 pound feeder animal with a 250 pound net gain at selected feeder cattle prices and feeding costs per pound of gain 1/

Total feeder cattle cost 2/	Total feeding cost per pound of gain (cents)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	Breakeven sales price (dollars/cwt)															
Dollars per 100 pounds:																
15.00	15.00	15.33	15.67	16.00	16.33	16.67	17.00	17.33	17.67	18.00	18.33	18.67	19.00	19.33	19.67	20.00
16.00	15.67	16.00	16.33	16.67	17.00	17.33	17.67	18.00	18.33	18.67	19.00	19.33	19.67	20.00	20.33	20.67
17.00	16.33	16.67	17.00	17.33	17.67	18.00	18.33	18.67	19.00	19.33	19.67	20.00	20.33	20.67	21.00	21.33
18.00	17.00	17.33	17.67	18.00	18.33	18.67	19.00	19.33	19.67	20.00	20.33	20.67	21.00	21.33	21.67	22.00
19.00	17.67	18.00	18.33	18.67	19.00	19.33	19.67	20.00	20.33	20.67	21.00	21.33	21.67	22.00	22.33	22.67
20.00	18.33	18.67	19.00	19.33	19.67	20.00	20.33	20.67	21.00	21.33	21.67	22.00	22.33	22.67	23.00	23.33
21.00	19.00	19.33	19.67	20.00	20.33	20.67	21.00	21.33	21.67	22.00	22.33	22.67	23.00	23.33	23.67	24.00
22.00	19.67	20.00	20.33	20.67	21.00	21.33	21.67	22.00	22.33	22.67	23.00	23.33	23.67	24.00	24.33	24.67
23.00	20.33	20.67	21.00	21.33	21.67	22.00	22.33	22.67	23.00	23.33	23.67	24.00	24.33	24.67	25.00	25.33
24.00	21.00	21.33	21.67	22.00	22.33	22.67	23.00	23.33	23.67	24.00	24.33	24.67	25.00	25.33	25.67	26.00
25.00	21.67	22.00	22.33	22.67	23.00	23.33	23.67	24.00	24.33	24.67	25.00	25.33	25.67	26.00	26.33	26.67
26.00	22.33	22.67	23.00	23.33	23.67	24.00	24.33	24.67	25.00	25.33	25.67	26.00	26.33	26.67	27.00	27.33
27.00	23.00	23.33	23.67	24.00	24.33	24.67	25.00	25.33	25.67	26.00	26.33	26.67	27.00	27.33	27.67	28.00
28.00	23.67	24.00	24.33	24.67	25.00	25.33	25.67	26.00	26.33	26.67	27.00	27.33	27.67	28.00	28.33	28.67
29.00	24.33	24.67	25.00	25.33	25.67	26.00	26.33	26.67	27.00	27.33	27.67	28.00	28.33	28.67	29.00	29.33
30.00	25.00	25.33	25.67	26.00	26.33	26.67	27.00	27.33	27.67	28.00	28.33	28.67	29.00	29.33	29.67	30.00
31.00	25.67	26.00	26.33	26.67	27.00	27.33	27.67	28.00	28.33	28.67	29.00	29.33	29.67	30.00	30.33	30.67
32.00	26.33	26.67	27.00	27.33	27.67	28.00	28.33	28.67	29.00	29.33	29.67	30.00	30.33	30.67	31.00	31.33
33.00	27.00	27.33	27.67	28.00	28.33	28.67	29.00	29.33	29.67	30.00	30.33	30.67	31.00	31.33	31.67	32.00
34.00	27.67	28.00	28.33	28.67	29.00	29.33	29.67	30.00	30.33	30.67	31.00	31.33	31.67	32.00	32.33	32.67
35.00	28.33	28.67	29.00	29.33	29.67	30.00	30.33	30.67	31.00	31.33	31.67	32.00	32.33	32.67	33.00	33.33
36.00	29.00	29.33	29.67	30.00	30.33	30.67	31.00	31.33	31.67	32.00	32.33	32.67	33.00	33.33	33.67	34.00
37.00	29.67	30.00	30.33	30.67	31.00	31.33	31.67	32.00	32.33	32.67	33.00	33.33	33.67	34.00	34.33	34.67
38.00	30.33	30.67	31.00	31.33	31.67	32.00	32.33	32.67	33.00	33.33	33.67	34.00	34.33	34.67	35.00	35.33
39.00	31.00	31.33	31.67	32.00	32.33	32.67	33.00	33.33	33.67	34.00	34.33	34.67	35.00	35.33	35.67	36.00
40.00	31.67	32.00	32.33	32.67	33.00	33.33	33.67	34.00	34.33	34.67	35.00	35.33	35.67	36.00	36.33	36.67

1/ Net gain assumes a 4 percent shrink at sale.
2/ Delivered or "laid-in" cost at the feedlot.

Table 17. Schedule of breakeven prices for a 500 pound feeder animal with a 300 pound net gain at selected feeder cattle prices and feeding costs per pound of gain 1/

Total feeder cattle cost 2/	Total feeding cost per pound of gain (cents)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	Breakeven sales price (dollars/cwt)															
Dollars per 100 pounds:																
15.00	15.00	15.38	15.75	16.13	16.50	16.88	17.25	17.63	18.00	18.38	18.75	19.13	19.50	19.88	20.25	20.63
16.00	15.63	16.00	16.38	16.75	17.13	17.50	17.88	18.25	18.63	19.00	19.38	19.75	20.13	20.50	20.88	21.25
17.00	16.25	16.63	17.00	17.38	17.75	18.13	18.50	18.88	19.25	19.63	20.00	20.38	20.75	21.13	21.50	21.88
18.00	16.88	17.25	17.63	18.00	18.38	18.75	19.13	19.50	19.88	20.25	20.63	21.00	21.38	21.75	22.13	22.50
19.00	17.50	17.88	18.25	18.63	19.00	19.38	19.75	20.13	20.50	20.88	21.25	21.63	22.00	22.38	22.75	23.13
20.00	18.13	18.50	18.88	19.25	19.63	20.00	20.38	20.75	21.13	21.50	21.88	22.25	22.63	23.00	23.38	23.75
21.00	18.75	19.13	19.50	19.88	20.25	20.63	21.00	21.38	21.75	22.13	22.50	22.88	23.25	23.63	24.00	24.38
22.00	19.38	19.75	20.13	20.50	20.88	21.25	21.63	22.00	22.38	22.75	23.13	23.50	23.88	24.25	24.63	25.00
23.00	20.00	20.38	20.75	21.13	21.50	21.88	22.25	22.63	23.00	23.38	23.75	24.13	24.50	24.88	25.25	25.63
24.00	20.63	21.00	21.38	21.75	22.13	22.50	22.88	23.25	23.63	24.00	24.38	24.75	25.13	25.50	25.88	26.25
25.00	21.25	21.63	22.00	22.38	22.75	23.13	23.50	23.88	24.25	24.63	25.00	25.38	25.75	26.13	26.50	26.88
26.00	21.88	22.25	22.63	23.00	23.38	23.75	24.13	24.50	24.88	25.25	25.63	26.00	26.38	26.75	27.13	27.50
27.00	22.50	22.88	23.25	23.63	24.00	24.38	24.75	25.13	25.50	25.88	26.25	26.63	27.00	27.38	27.75	28.13
28.00	23.13	23.50	23.88	24.25	24.63	25.00	25.38	25.75	26.13	26.50	26.88	27.25	27.63	28.00	28.38	28.75
29.00	23.75	24.13	24.50	24.88	25.25	25.63	26.00	26.38	26.75	27.13	27.50	27.88	28.25	28.63	29.00	29.38
30.00	24.38	24.75	25.13	25.50	25.88	26.25	26.63	27.00	27.38	27.75	28.13	28.50	28.88	29.25	29.63	30.00
31.00	25.00	25.38	25.75	26.13	26.50	26.88	27.25	27.63	28.00	28.38	28.75	29.13	29.50	29.88	30.25	30.63
32.00	25.63	26.00	26.38	26.75	27.13	27.50	27.88	28.25	28.63	29.00	29.38	29.75	30.13	30.50	30.88	31.25
33.00	26.25	26.63	27.00	27.38	27.75	28.13	28.50	28.88	29.25	29.63	30.00	30.38	30.75	31.13	31.50	31.88
34.00	26.88	27.25	27.63	28.00	28.38	28.75	29.13	29.50	29.88	30.25	30.63	31.00	31.38	31.75	32.13	32.50
35.00	27.50	27.88	28.25	28.63	29.00	29.38	29.75	30.13	30.50	30.88	31.25	31.63	32.00	32.38	32.75	33.13
36.00	28.13	28.50	28.88	29.25	29.63	30.00	30.38	30.75	31.13	31.50	31.88	32.25	32.63	33.00	33.38	33.75
37.00	28.75	29.13	29.50	29.88	30.25	30.63	31.00	31.38	31.75	32.13	32.50	32.88	33.25	33.63	34.00	34.38
38.00	29.38	29.75	30.13	30.50	30.88	31.25	31.63	32.00	32.38	32.75	33.13	33.50	33.88	34.25	34.63	35.00
39.00	30.00	30.38	30.75	31.13	31.50	31.88	32.25	32.63	33.00	33.38	33.75	34.13	34.50	34.88	35.25	35.63
40.00	30.63	31.00	31.38	31.75	32.13	32.50	32.88	33.25	33.63	34.00	34.38	34.75	35.13	35.50	35.88	36.25

1/ Net gain assumes a 4 percent shrink at sale.

2/ Delivered or "laid-in" cost at the feedlot.

Table 18. Schedule of breakeven prices for a 500 pound feeder animal with a 350 pound net gain at selected feeder cattle prices and feeding costs per pound of gain 1/

Total feeder cattle cost 2/	Total feeding cost per pound of gain (cents)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	Breakeven sales price (dollars/cwt)															
Dollars per 100 pounds:																
15.00	15.00	15.41	15.82	16.24	16.65	17.06	17.47	17.88	18.29	18.71	19.12	19.53	19.94	20.35	20.76	21.18
16.00	15.59	16.00	16.41	16.82	17.24	17.65	18.06	18.47	18.88	19.29	19.71	20.12	20.53	20.94	21.35	21.76
17.00	16.18	16.59	17.00	17.41	17.82	18.24	18.65	19.06	19.47	19.88	20.29	20.71	21.12	21.53	21.94	22.35
18.00	16.76	17.18	17.59	18.00	18.41	18.82	19.24	19.65	20.06	20.47	20.88	21.29	21.71	22.12	22.53	22.94
19.00	17.35	17.76	18.18	18.59	19.00	19.41	19.82	20.24	20.65	21.06	21.47	21.88	22.29	22.71	23.12	23.53
20.00	17.94	18.35	18.76	19.18	19.59	20.00	20.41	20.82	21.24	21.65	22.06	22.47	22.88	23.29	23.71	24.12
21.00	18.53	18.94	19.35	19.76	20.18	20.59	21.00	21.41	21.82	22.24	22.65	23.06	23.47	23.88	24.29	24.71
22.00	19.12	19.53	19.94	20.35	20.76	21.18	21.59	22.00	22.41	22.82	23.24	23.65	24.06	24.47	24.88	25.29
23.00	19.71	20.12	20.53	20.94	21.35	21.76	22.18	22.59	23.00	23.41	23.82	24.24	24.65	25.06	25.47	25.88
24.00	20.29	20.71	21.12	21.53	21.94	22.35	22.76	23.18	23.59	24.00	24.41	24.82	25.24	25.65	26.06	26.47
25.00	20.88	21.29	21.71	22.12	22.53	22.94	23.35	23.76	24.18	24.59	25.00	25.41	25.82	26.24	26.65	27.06
26.00	21.47	21.88	22.29	22.71	23.12	23.53	23.94	24.35	24.76	25.18	25.59	26.00	26.41	26.82	27.24	27.65
27.00	22.06	22.47	22.88	23.29	23.71	24.12	24.53	24.94	25.35	25.76	26.18	26.59	27.00	27.41	27.82	28.24
28.00	22.65	23.06	23.47	23.88	24.29	24.71	25.12	25.53	25.94	26.35	26.76	27.18	27.59	28.00	28.41	28.82
29.00	23.24	23.65	24.06	24.47	24.88	25.29	25.71	26.12	26.53	26.94	27.35	27.76	28.18	28.59	29.00	29.41
30.00	23.82	24.24	24.65	25.06	25.47	25.88	26.29	26.71	27.12	27.53	27.94	28.35	28.76	29.18	29.59	30.00
31.00	24.41	24.82	25.24	25.65	26.06	26.47	26.88	27.29	27.71	28.12	28.53	28.94	29.35	29.76	30.18	30.59
32.00	25.00	25.41	25.82	26.24	26.65	27.06	27.47	27.88	28.29	28.71	29.12	29.53	29.94	30.35	30.76	31.18
33.00	25.59	26.00	26.41	26.82	27.24	27.65	28.06	28.47	28.88	29.29	29.71	30.12	30.53	30.94	31.35	31.76
34.00	26.18	26.59	27.00	27.41	27.82	28.24	28.65	29.06	29.47	29.88	30.29	30.71	31.12	31.53	31.94	32.35
35.00	26.76	27.18	27.59	28.00	28.41	28.82	29.24	29.65	30.06	30.47	30.88	31.29	31.71	32.12	32.53	32.94
36.00	27.35	27.76	28.18	28.59	29.00	29.41	29.82	30.24	30.65	31.06	31.47	31.88	32.29	32.71	33.12	33.53
37.00	27.94	28.35	28.76	29.18	29.59	30.00	30.41	30.82	31.24	31.65	32.06	32.47	32.88	33.29	33.71	34.12
38.00	28.53	28.94	29.35	29.76	30.18	30.59	31.00	31.41	31.82	32.24	32.65	33.06	33.47	33.88	34.29	34.71
39.00	29.12	29.53	29.94	30.35	30.76	31.18	31.59	32.00	32.41	32.82	33.24	33.65	34.06	34.47	34.88	35.29
40.00	29.71	30.12	30.53	30.94	31.35	31.76	32.18	32.59	33.00	33.41	33.82	34.24	34.65	35.06	35.47	35.88

1/ Net gain assumes a 4 percent shrink at sale.
2/ Delivered or "laid-in" cost at the feedlot.

which was 22 cents per hundredweight lower than a 300-pound net gain, Tables 17 and 18.

Feeder cattle costs in Table 18 can also be used to demonstrate the effect of area differences in feeder cattle costs on breakeven prices. For example, if laid-in costs for a feeder animal in feeding area A is $24.00 per hundredweight compared to $27.00 for a similar animal in area B, with total feeding cost equal to 22 cents per pound of gain in both areas, the breakeven price in area A is $23.18 compared to $24.94 in area B. The $3 differential, per hundredweight, in feeder cattle costs results in a breakeven price differential of $1.76 per hundredweight or a total feeding cost differential of $14.96 per head.

EFFECT OF GRAIN SORGHUM PRICE CHANGES ON FEED COSTS

Efficiency in the feedlot industry, as in other industries, is dependent upon such things as up-to-the-minute knowledge of the price of resource inputs and the effect of such price changes on production costs. The price of grain sorghum, one of the major feed ingredients in the Southern Plains, may vary both among and within feeding areas.

The effect of grain sorghum price changes or differentials on feed costs per pound of gain can be seen in Tables 19 and 20. For example, for each $1 increase in the price per ton of grain sorghum, feed costs increase 66 cents per head [(.1530 — .1500) (220)] for a feeder animal fed a daily ration of 12 pounds of grain sorghum for 110 days when other feed costs are held constant at $0.0600 per pound of gain. In contrast, feed costs rise about $1.08 per head for each dollar increase per ton in the price of grain sorghum for an animal fed 16 pounds of grain sorghum per day for 135 days when other feed costs are held constant at $0.0700 per pound of gain. The latter example demonstrates that when the price of grain sorghum declines from $38 to $34 per ton, as occurred in the Southern Plains between 1966-67 and 1968, feeding costs may decline as much as $4.35 per head when other feed costs are held constant.

Table 19. Effect of grain sorghum price changes or differentials on feed costs for a 110-day feeding period at selected rates of gain 1/

Grain sorghum price	Marketable gain (pounds)2/			
	220	275	330	385
	Feed cost/pound of gain (dollars)			
Dollars per ton:				
$ 30.00	.1500	.1320	.1200	.1114
31.00	.1530	.1344	.1220	.1131
32.00	.1560	.1368	.1240	.1149
33.00	.1590	.1392	.1260	.1166
34.00	.1620	.1416	.1280	.1183
35.00	.1650	.1440	.1300	.1200
36.00	.1680	.1464	.1320	.1217
37.00	.1710	.1488	.1340	.1234
38.00	.1740	.1512	.1360	.1251
39.00	.1770	.1536	.1380	.1269
40.00	.1800	.1560	.1400	.1286
41.00	.1830	.1584	.1420	.1303
42.00	.1860	.1608	.1440	.1320
43.00	.1890	.1632	.1460	.1337
44.00	.1920	.1656	.1480	.1354
45.00	.1950	.1680	.1500	.1371

1/ Assuming a feeding period of 110 days and a daily grain sorghum consumption rate of 12 pounds. Feed costs include a constant charge of $ .0600 for other feed ingredients.

2/ Assuming a 2.0, 2.5, 3.0, and 3.5 marketable rate of gain per head per day respectively.

Table 20. Effect of grain sorghum price changes or differentials on feed costs for a 135-day feeding period at selected rates of gain 1/

Grain sorghum price	Marketable gain (pounds)2/			
	270	337.5	405	472.5
	Feed cost/pound of gain (dollars)			
Dollars per ton:				
$ 30.00	.1900	.1660	.1500	.1386
31.00	.1940	.1692	.1527	.1409
32.00	.1980	.1724	.1553	.1431
33.00	.2020	.1756	.1580	.1454
34.00	.2060	.1788	.1607	.1477
35.00	.2100	.1820	.1633	.1500
36.00	.2140	.1852	.1660	.1523
37.00	.2180	.1884	.1687	.1546
38.00	.2220	.1916	.1713	.1569
39.00	.2260	.1948	.1740	.1591
40.00	.2300	.1980	.1767	.1614
41.00	.2340	.2012	.1793	.1637
42.00	.2380	.2044	.1820	.1660
43.00	.2420	.2076	.1846	.1683
44.00	.2460	.2108	.1873	.1706
45.00	.2500	.2140	.1900	.1729

1/ Assuming a feeding period of 135 days and a daily grain sorghum consumption rate of 16 pounds. Feed costs include a constant charge of $.0700 for other feed ingredients.

2/ Assuming a 2.0, 2.5, 3.0, and 3.5 marketable rate of gain per head per day, respectively.

Tables 19 and 20 also demonstrate the effect of grain sorghum price differentials among various feeding areas. During 1966-67, grain sorghum prices were approximately $3 per ton higher in the Texas Gulf Coast-Rio Grande Plains feeding area than in the Texas Panhandle-Plains area. Given such a grain sorghum price differential and provided the same type of feeder cattle were placed on feed under similar feeding conditons in each area, feed costs would have been $1.98 per head higher in the Gulf Coast-Rio Grande Plains than in the Texas Panhandle-Plains area for a 110-day feeding period, Table 19. Similarly, feed costs would have been $3.24 per head higher in the Gulf Coast-Rio Grande Plains area for a 135-day feeding period, Table 20. These data suggest that feeding areas as the Gulf Coast-Rio Grande Plains, which are faced with a competitive disadvantage with respect to grain sorghum prices, can more nearly compete by feeding light weight feeder cattle for relatively short feeding periods.

EFFECT OF DAILY RATE OF GAIN ON FEED COSTS AND CUSTOM FEEDING CHARGES PER POUND OF GAIN

Daily rates of gain are of prime importance when feed costs and total feeding costs are analyzed on a per-pound-of-gain basis. Fluctuations in daily rates of gain, therefore, have important implications for the feedlot operator and clients of the custom feeder.

Table 21. Effect of daily rate of gain on feed cost, per pound of marketable gain, for selected feeding periods 1/

Daily rate of gain (pounds)	Feeding period (days) 2/				
	100	110	120	130	140
	Feed cost/pound of gain (dollars)				
2.0	.1733	.1829	.1925	.2021	.2118
2.1	.1650	.1742	.1833	.1925	.2017
2.2	.1575	.1663	.1750	.1838	.1925
2.3	.1506	.1590	.1674	.1758	.1841
2.4	.1444	.1524	.1604	.1684	.1765
2.5	.1386	.1463	.1540	.1617	.1694
2.6	.1333	.1407	.1481	.1555	.1629
2.7	.1283	.1355	.1426	.1497	.1569
2.8	.1238	.1306	.1375	.1444	.1512
2.9	.1195	.1261	.1328	.1394	.1460
3.0	.1155	.1219	.1283	.1348	.1412
3.1	.1118	.1180	.1242	.1304	.1366
3.2	.1083	.1143	.1203	.1263	.1323

1/ Assuming feed costs of $38.50 per ton.

2/ Assumes a daily feed consumption rate of 18, 19, 20, 21, and 22 pounds, respectively.

Table 22. Effect of daily rate of gain on feed cost, per pound of marketable gain, for selected feeding periods 1/

Daily rate of gain (pounds)	Feeding period (days) 2/				
	100	110	120	130	140
	Feed cost/pound of gain (dollars)				
2.0	.1912	.2019	.2125	.2231	.2338
2.1	.1821	.1923	.2024	.2125	.2226
2.2	.1739	.1835	.1932	.2028	.2125
2.3	.1663	.1755	.1848	.1940	.2033
2.4	.1594	.1682	.1771	.1859	.1948
2.5	.1530	.1615	.1700	.1785	.1870
2.6	.1471	.1553	.1635	.1716	.1798
2.7	.1417	.1495	.1574	.1653	.1731
2.8	.1366	.1442	.1518	.1594	.1670
2.9	.1319	.1392	.1466	.1539	.1612
3.0	.1275	.1346	.1417	.1488	.1558
3.1	.1234	.1302	.1371	.1440	.1508
3.2	.1195	.1262	.1328	.1395	.1461

1/ Assuming feed costs of $42.50 per ton.

2/ Assumes a daily feed consumption rate of 18, 19, 20, 21, and 22 pounds, respectively.

Tables 21 and 22 show changes in feed cost per pound of gain as daily rates of gain increase for selected feeding periods with associated daily feed consumption rates.[12] For example, if we assume a feeding period of 100 days, a daily feed consumption rate of 18 pounds per head and feed costs of $38.50 per ton, changes in daily rates of gain from 2.0 to 2.1 pounds result in decreased feeding costs equal to $0.0083 ($0.1733 — $0.1650) per pound of gain, Table 21. This decline in feeding cost is equivalent to $0.0174 per day ($0.0083 × 2.1) or $1.74 per head ($0.0174 × 100). Similarly, if the daily rates of gain had increased from 3.1 to 3.2 pounds for a 100-day feed period, feed costs would have declined $1.12 per head. If the feeding period had been extended to 140 days with a daily feed consumption rate of 22 pounds per head and feed costs at $38.50 per ton, feed costs would have declined $2.97 per head with increases in daily rates of gain from 2.0 to 2.1 pounds. However, if the daily rate of gain for a 140-day feeding period had increased from 3.1 to 3.2 pounds, feed costs would have declined $1.93 per head. These results indicate that substantial savings in feed costs are possible as daily rates of gain increase one-tenth pound per head. In addition, differences in feed costs per pound of gain tend to increase as feeding periods are extended along with associated increases in daily feed consumption rates. Also, differences in feed cost per pound of gain, for similar feeding periods, tend to decrease as daily rates of gain increase in accordance with the assumptions made in Table 21.

When feed costs are assumed to increase from $38.50 to $42.50 per ton, feeding costs increase $0.0179 per pound of gain for a 100-day period with a 2-pound daily rate of gain, Tables 21 and 22. However, if the daily rate of gain had been 3.2 pounds for a 100-day feeding period, the increase in feed cost would have been $0.0112 per pound of gain.

Tables 23 and 24 demonstrate the effect of changes in daily rates of gain on custom feeding charges. Total custom feeding costs decrease $0.0107 per pound of gain when the daily rate of gain increases from 2.0 to 2.1 pounds for a 100-day feeding period with basic feed costs held constant at $38.50 per ton, Table 23. This decline is equivalent to $2.25 per head compared to $2.42 per head when basic feed costs are $42.50 per ton, Table 24.

These results indicate the extreme sensitivity of changes in daily rates of gain to both feed costs and custom feeding costs per pound of gain. These results also suggest that feedlot operators who analyze rates of gain on a frequent basis are in a relatively favorable position to realize possible savings or reductions in feed costs.

ECONOMIES OF SIZE

Analyses of cost curves are useful for determining the efficiency of feedlots relative to the level of output or production. Short-run average cost curves (SAC_1, SAC_2, SAC_3), as shown in Figure 3, represent three

Table 23. Effect of daily rate of gain on custom feeding costs, per pound of marketable gain, for selected feeding periods 1/

Daily rate of gain (pounds)	Feeding period (days) 2/				
	100	110	120	130	140
	Total feeding cost/pound of gain (dollars)				
2.0	.2245	.2344	.2446	.2550	.2655
2.1	.2138	.2232	.2329	.2428	.2529
2.2	.2041	.2131	.2223	.2318	.2414
2.3	.1952	.2038	.2127	.2217	.2309
2.4	.1871	.1953	.2038	.2125	.2212
2.5	.1796	.1875	.1957	.2040	.2124
2.6	.1727	.1803	.1881	.1961	.2042
2.7	.1663	.1736	.1812	.1889	.1967
2.8	.1604	.1674	.1747	.1821	.1896
2.9	.1548	.1617	.1687	.1758	.1831
3.0	.1497	.1563	.1631	.1700	.1770
3.1	.1448	.1512	.1578	.1645	.1713
3.2	.1403	.1465	.1529	.1594	.1659

1/ Assuming custom feeding charges of $38.50 per ton, plus a mark-up of $7.50 per ton for handling and other charges and $3.50 per head for medication, vaccination, branding, etc.

2/ Assumes a daily feed consumption rate of 18, 19, 20, 21, and 22 pounds, respectively.

[12] Feed cost per pound of gain =

$$\frac{\frac{[(\text{Daily Consumption})(\text{Feeding Period})]}{2{,}000}\ [\text{Feed Cost/Ton}]}{(\text{Daily Rate of Gain})\ (\text{Feeding Period})}$$

Table 24. Effect of daily rate of gain on custom feeding costs, per pound of marketable gain, for selected feeding periods 1/

Daily rate of gain (pounds)	Feeding period (days) 2/				
	100	110	120	130	140
	Total feeding cost/pound of gain (dollars)				
2.0	.2425	.2534	.2646	.2760	.2875
2.1	.2310	.2413	.2520	.2628	.2738
2.2	.2205	.2304	.2405	.2509	.2614
2.3	.2109	.2204	.2301	.2400	.2500
2.4	.2021	.2112	.2205	.2300	.2396
2.5	.1940	.2027	.2117	.2208	.2300
2.6	.1865	.1949	.2035	.2123	.2212
2.7	.1796	.1877	.1960	.2044	.2130
2.8	.1732	.1810	.1890	.1971	.2054
2.9	.1672	.1748	.1825	.1903	.1983
3.0	.1617	.1689	.1764	.1840	.1917
3.1	.1565	.1635	.1707	.1780	.1855
3.2	.1516	.1584	.1654	.1725	.1797

1/ Assuming custom feeding charges of $42.50 per ton, plus a mark-up of $7.50 per ton for handling and other charges and $3.50 per head for medication, vaccination, branding etc.

2/ Assumes a daily feed consumption rate of 18, 19, 20, 21 and 22 pounds, respectively.

specific but successively larger feed mills for three different sizes of feedlots. Production costs may vary in each feedlot as output increases or decreases in relation to feedlot utilization rate. The long-run average cost curve (LAC) represents an envelope curve which is tangent to each of the short-run average cost curves and is a theoretical expansion path of minimum per-unit production costs as feedlots increase in size.

Levels of production as indicated in Figure 3 at point A on SAC_1, point B on SAC_2 and point C on SAC_3 represent least cost long-run feeding levels for these outputs. Each of the short-run average cost curves represents an infinitestimal number of costs whose points are determined by varying feedlot utilization rates for the specified feed mill capacity. When feeding facilities as represented by SAC_1 are under-utilized, costs per pound of gain tend to move to the left on SAC_1 from point A. In contrast, when feeding facilities are over-utilized, costs tend to rise and move to the right on the short-run curve from the minimum point. The intersection of SAC_1 and SAC_2 represents that point at which a feedlot would be expected to

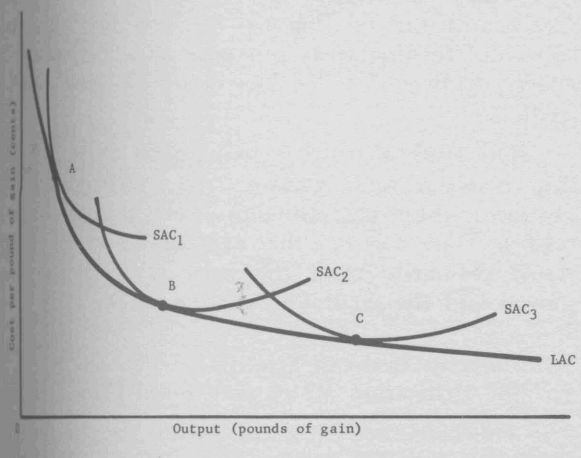


Figure 3. Theoretical cost curves for a feedlot.

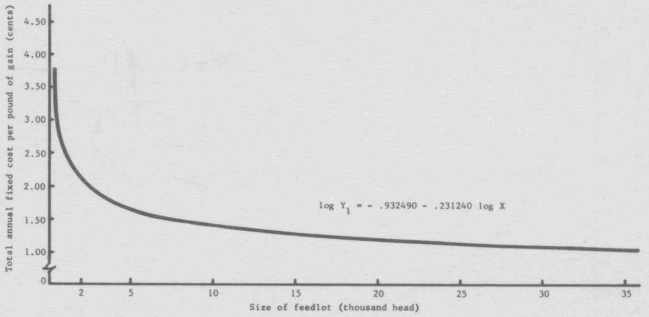


Figure 4. Relationship between size of feedlot and total annual fixed costs, per pound of gain, for all size feedlots, Texas and Oklahoma, 1966-67.

expand its feeding facilities and install a larger feed mill.

If the long-run average cost curve declines as output increases, then successively larger sizes of feedlots are more efficient than the smaller feedlots as a result of existing economies of size. As a general rule, economies of size are available in those industries in which division and specialization of labor are present and in which advanced technological developments in machinery and equipment can readily be applied.[13] However, increases in the long-run average costs beyond the minimum point on the long-run average cost curve indicate that successively larger scales or sizes of feedlots become less and less efficient. That is, average costs per unit of output for successively larger feedlots tend to increase. With new technology and capital restrictions, it is possible that no feedlots have been constructed in the Southern Plains that exceed the minimum point on the cost curve.

The regression model adopted for use in this study was a non-linear model in which the variables are expressed in logarithms.[14] Cost functions were developed for measuring the relationship between (1) feedlot size and various items of fixed cost, total fixed cost and total feeding cost and (2) feedlot size and total fixed cost under varying assumptions regarding degree-of-feedlot-utilization rates.

Relationship Between Total Fixed Costs and Size of Feedlot

Figures 4 and 5, which depict the relationship of feedlot size and total fixed costs, reveal that substantial economies of size existed in Texas and Oklahoma feedlot operations during 1966-67. These economies are apparent when total feedlots are analyzed as in Figure 4 or when feedlots with 1,000-head-and-over capacity are considered as in Figure 5. The degree of feedlot utilization rates in cost curves

[13] Leftwich, R. H., *The Price System and Resource Allocation*, Holt, Rinehart and Winston, New York, Revised Edition, 1960.

[14] Four regression models consisting of one linear model and three nonlinear models were postulated for analyzing economies of size. Regression models employed for deriving cost curves are discussed in Appendix C.

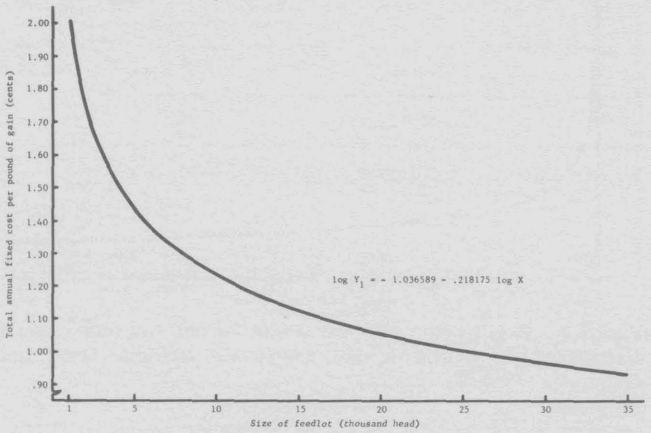


Figure 5. Relationship between size of feedlot and total annual fixed costs, per pound of gain, for feedlots with 1,000-head-and-over capacity, Texas and Oklahoma, 1966-67.

representing feedlots with 1,000-head-or-more capacity was held constant at the average 1966-67 rate (72.84 percent).

Figure 4 suggests that feedlots with less than 5,000 to 10,000-head capacity are at a competitive disadvantage with respect to annual fixed costs per pound of gain compared to larger size feedlot operations. For example, Figure 4 shows that feedlots with a one-time feeding capacity of 400 head experienced total annual fixed costs equivalent to about 3 cents per pound of gain as compared to 1.4 cents per pound of gain for feedlots with 10,000-head capacity. This differential is even greater when feedlots with more than 10,000-head capacity are considered. Figure 5 shows a substantial difference in total annual fixed costs per pound of gain between feedlots with 1,000-head capacity and feedlots with 30,000-head-and-over capacity. These results suggest that size or capacity of feedlots has not been expanded within the limits of present feedlot technology. Several factors apparently contribute to lower fixed costs per pound of gain as feedlots increase in size. These include higher degrees of utilization rates, more specialized labor and management and higher degrees of mechanization.[15]

Relationship Between Individual Fixed Cost Components and Size of Feedlot

The individual fixed-cost components which included depreciation, interest, insurance, taxes, fixed labor and repairs revealed the same general relationship to size, Figures 6 and 7. Feedlots with less than 5,000 - 10,000-head feeding capacity were generally at a competitive feeding disadvantage relative to feedlots with more than 10,000-head feeding capacity.

The relationship of feedlot size to annual depreciation and fixed labor costs was almost identical in both Figures 6 and 7. Each of these fixed cost items also accounted for about one-third of the total annual fixed costs. However, the various statistical tests indicate that depreciation cost, per pound of gain, was more strongly influenced by feedlot size than was fixed labor cost, Appendix C. The cost curves in Figure 7 are at slightly lower levels than those in Figure 6, since data in Figure 7 include only feedlots with 1,000-head-and-over capacity.

Although annual interest and repair costs each accounted for about 15 percent of the total annual fixed costs, the various statistical tests indicate that annual repairs were not significantly influenced by feedlot size as were annual interest costs, Appendix C. Annual interest cost declined as feedlots increased in size and had higher feedlot utilization rates. Annual repair costs apparently are influenced more by such factors as exposure to weather and elements, rate of utilization and obsolescence than by size of feedlot.

Annual taxes and insurance on fixed investment accounted for only 3 - 4 percent of the total annual fixed costs, but they are strongly influenced by feedlot size. Insurance costs and taxes in Figure 6 decreased by about one-third as feedlots increased in size from less than 1,000-head to more than 30,000-head capacity. This decline reflects both economies of size and degree-of-feedlot-utilization rates.

Relationship Between Total Feeding Cost and Size of Feedlot

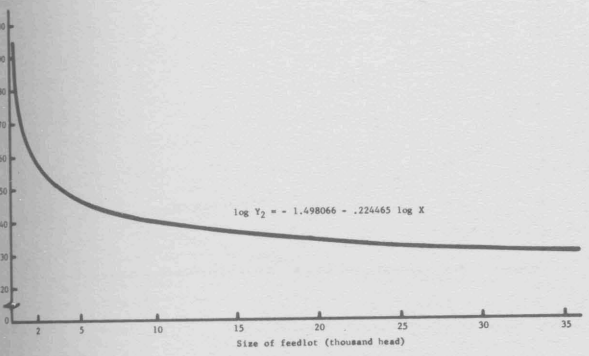
Figure 8 shows that total feeding costs were 2.5 cents higher per pound of gain for feedlots with 1,000-head capacity than for lots with 35,000-head capacity. In contrast, total feeding costs were about 4 cents per pound of gain higher for feedlots with 200-head capacity compared to those with 35,000-head capacity. Lower total feeding costs as feedlots increase in size are generally attributable to size of feedlot and feedlot-utilization rate. Additional factors which affect total feeding costs, but which were not included in the total feeding cost function, include management, level of technology, location, type of cattle placed on feed, type of ration, length of time on feed, feed cost, in-weight, out-weight, sex and others. Analysis of the relationship between such variables and total feeding costs can generally be made most effectively by a detailed case study of a few selected feedlots.

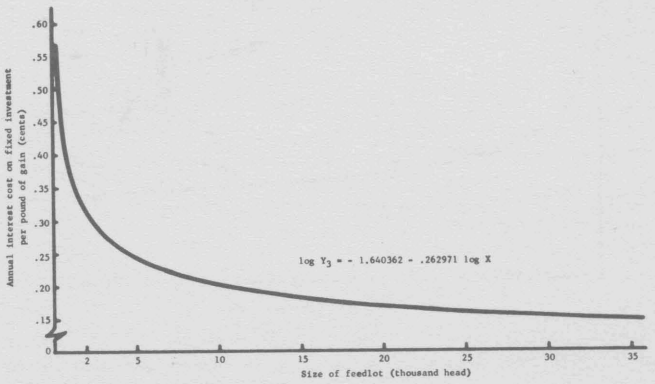
This study also attempted to measure the relationship between total variable costs and feedlot size. However, these measurements were generally unsuccessful. This suggests that existing economies of size result primarily from the level of technology employed and the feedlot utilization rates.

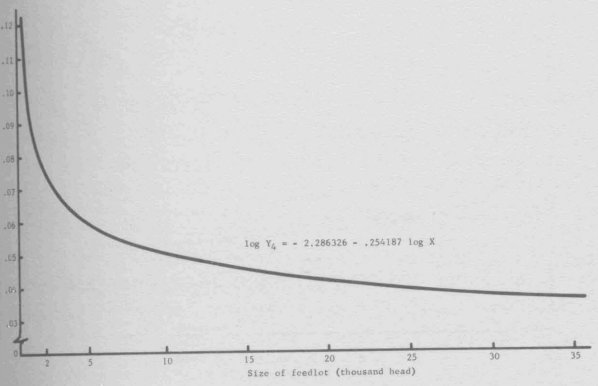
Relationship Between Size of Feedlot, Feedlot Utilization Rates and Total Fixed Costs

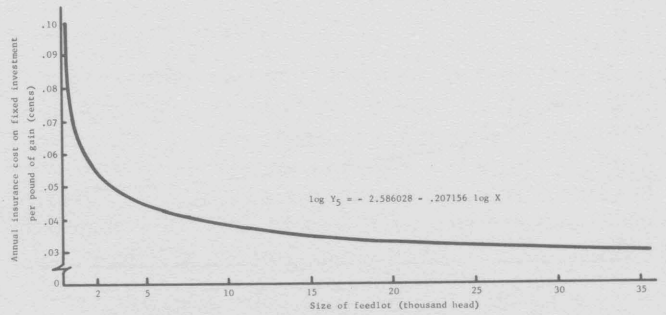
The combined effect of feedlot size and 1966-67 feedlot utilization rates on total annual fixed costs

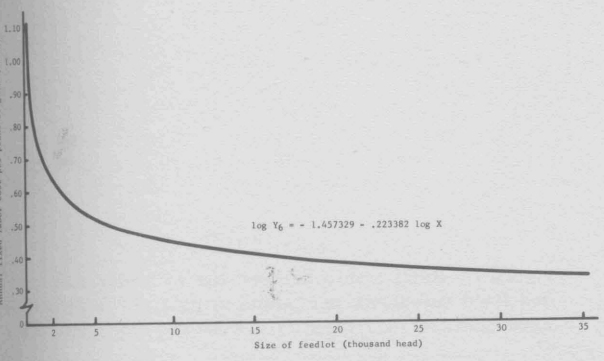
[15]The effect of utilization rates are shown in Figures 9 and 10 and in Appendix C.











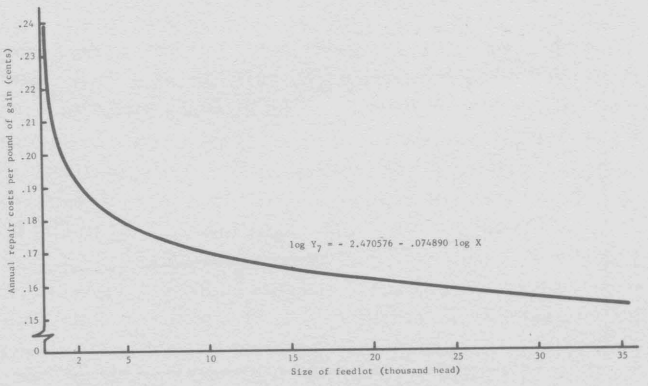
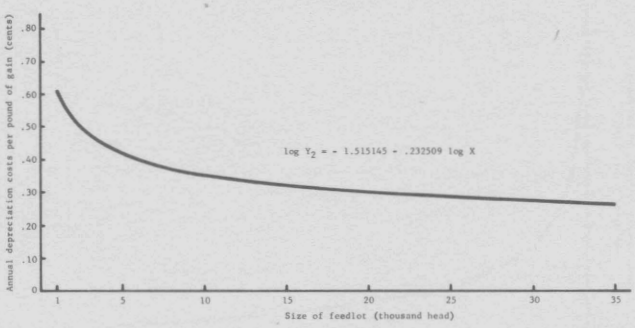
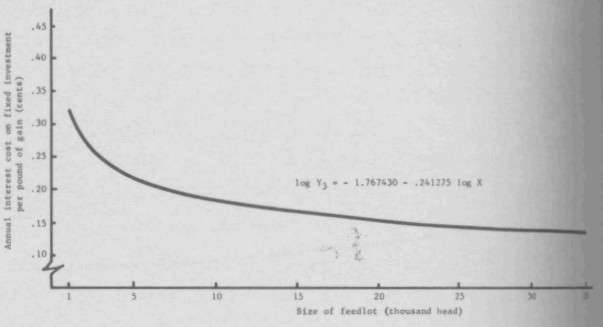
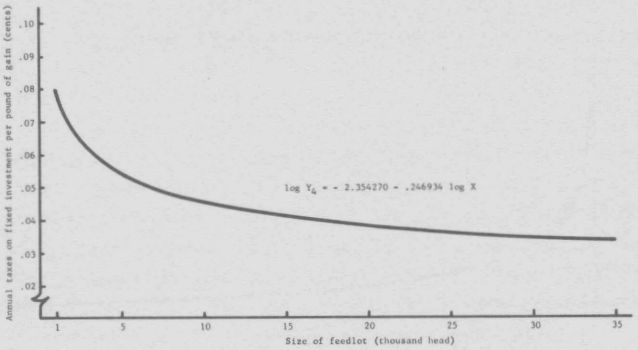
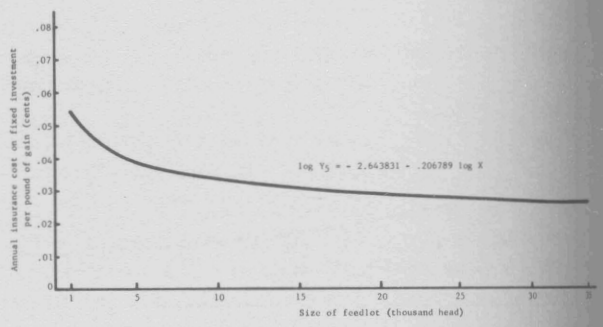


Figure 6. Relationship between size of feedlot and specified fixed cost items, per pound of gain, for all size feedlots, Texas and Oklahoma, 1966-67.









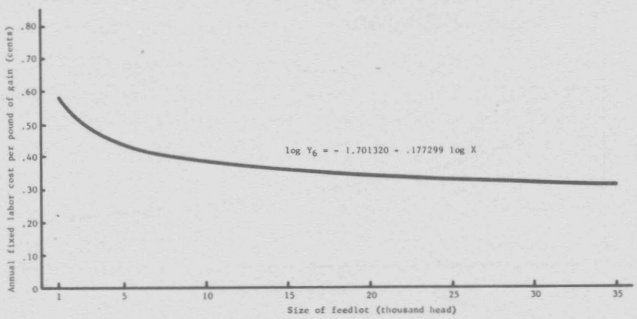


Figure 7. Relationship between size of feedlot and specified fixed cost items, per pound of gain, for feedlots with 1,000-head-and-over capacity, Texas and Oklahoma, 1966-67.

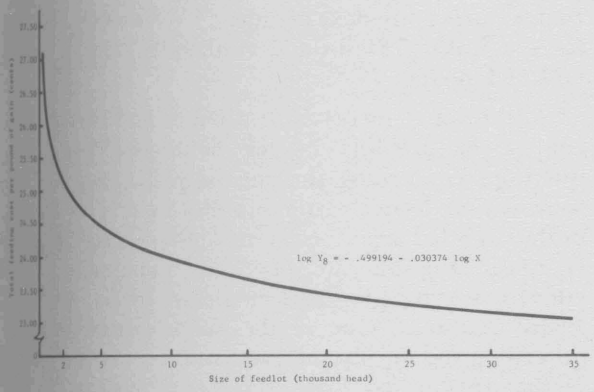


Figure 8. Relationship between size of feedlot and total feeding costs, per pound of gain, for all size feedlots, Texas and Oklahoma, 1966-67.

are shown in Figure 9. The higher cost curve for feedlots with 1,000 - 4,999-head capacity compared to lots with 5,000 - 9,999-head capacity is the result of economies of size and differences in feedlot utilization rates. The effect of a relatively lower utilization rate is most noticeable for feedlots with 25,000 - 29,999-head capacity.

The competitive advantage due to size, however, tends to decline when feedlot utilization rates are held constant at consecutively higher levels over all size groups, Figure 10. For example, when feedlot utilization rates are held constant at 25 percent over all size groups, total annual fixed costs are approximately 2 cents per pound of gain higher for feedlots with 1,000-head capacity compared to feedlots approaching 35,000-head capacity. This difference, however, declines to 1.2 cents per pound of gain when utilization rates are held constant at the 75-percent level. Figure 10 suggests that as Southern Plains feedlots approach 100-percent utilization rates, feedlots with less than 10,000-head capacity are generally at a substantial disadvantage with respect to fixed costs per pound of gain when competing with feedlots with more than 10,000-head feeding capacity. These results also show that total annual fixed costs decrease substantially as feedlot utilization rates increase from 25 to 50 percent. Figure 10 reveals that total annual fixed costs for feedlots with 1,000-head capacity declined 1.3 cents per pound of gain as feedlot utilization rates increased from 25 to 50 percent. This compares to a decline of about .6 cent per pound of gain for feedlots with 35,000-head capacity.

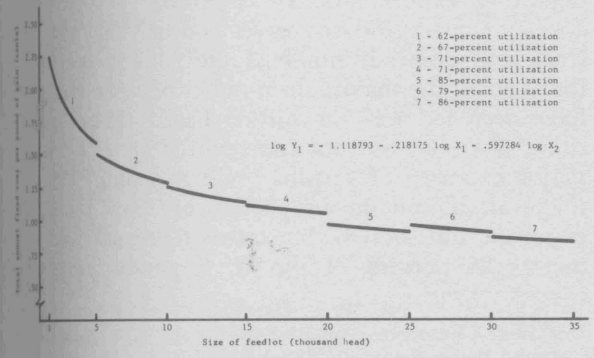


Figure 9. Relationship between size of feedlot and total annual fixed costs, per pound of gain, as affected by actual degrees of feedlot utilization, Texas and Oklahoma, 1966-67.

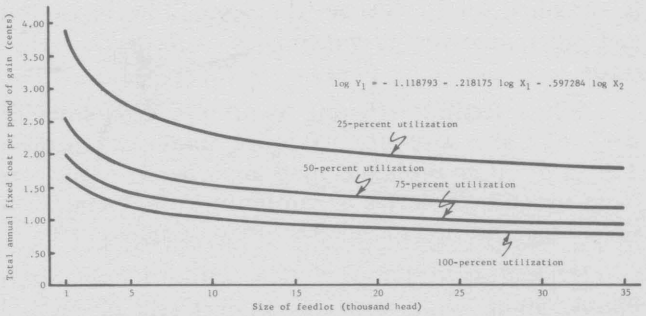


Figure 10. Relationship between size of feedlot and total annual fixed costs, per pound of gain, with varying degrees of feedlot utilization, Texas and Oklahoma, 1966-67.

SUMMARY AND SELECTED IMPLICATIONS

Summary

Substantial changes have occurred in the structural and operational characteristics of the Southern Plains cattle feeding industry. Future changes, however, may be even more dramatic as feedlots attempt to realize competitive advantages through economies of size, location, use of computer sciences and introduction of new technology.

Results from this study suggest that large commercial feedlots will increase in size and number within the Southern Plains during the next decade. Feedlots with less than 1,000-head capacity are accounting for a relatively small proportion of the total cattle fed in Texas and Oklahoma. The importance of feedlots with less than 5,000-head capacity is also expected to decline substantially during the next decade. Results from this study revealed that feedlots with 10,000-head-and-over capacity generally possessed a competitive advantage over smaller feedlots. Such feeding advantages resulted primarily from existing economies of size, higher feedlot utilization rates and lower labor costs as a result of higher levels of mechanization. Results further indicated that costs decreased at a declining rate as feedlots approached 30,000-head-and-over capacity. This suggests that feedlots have not expanded beyond the limits of present technology and that further increases in size are economically feasible. It is also probable that as feedlot size limitations are reached with respect to production costs for given levels of technology, continuing innovations and further improvements in milling equipment, feed handling devices and computer management techniques will extend feedlot size limitations beyond existing levels. The adaptation of such technology

is, of course, dependent on the availability of capital and other necessary resources such as feed and feeder cattle.

While feedlots attempt to achieve economies of size, they also seek to maximize total net income. Therefore, it is probable that some feedlots may expand beyond the levels of minimum costs for a given size range and accept a lower per-unit net return.

Expanding feedlot operations within the Southern Plains, along with relatively high levels of annual fixed costs, have encouraged large commercial feedlots to maintain high levels of feedlot utilization rates in order to spread annual fixed costs over larger units of output. When annual fixed costs were analyzed on the basis of pound of gain, feedlots with 10,000-head-and-over capacity experienced annual fixed costs which were 50 percent or more below those of feedlots with less than 5,000-head capacity. Consequently, most feedlots with less than 5,000-head capacity are faced with a substantial competitive disadvantage unless they are able to increase feedlot utilization rates or adopt other cost saving practices.

Attempts to find economies of size in total variable costs as a result of bulk buying of feed and other inputs by Southern Plains feedlots were generally not successful. Findings did reveal that as feedlots increased in size, larger feedlots were generally able to utilize variable labor more efficiently than smaller feedlots. In addition, results showed that feedlot operators who are well informed relative to the effects of price changes in feed ingredients as well as the effects of changes in daily rates of gain on feeding costs are generally in a relatively favorable position to realize potential cost savings. For example, for each 1-dollar increase in the price per ton of grain sorghum, feed costs increased from 66 cents per head for a 110-day feeding period to $1.09 per head for a 135-day feeding period. These results have important implications for locating feedlots as well as for adopting feeding programs most suitable for areas facing relatively higher feed costs. An increase in the price per ton of grain sorghum or a price differential between feeding areas of $3.00 per ton translates into increased feeding costs of $1.98 - $3.24 per head depending upon length of time on feed. Feeding areas which are faced with a competitive disadvantage with respect to grain sorghum prices may therefore find it advantageous to feed light weight feeder cattle for relatively short feeding periods.

Selected Implications

The Southern Plains cattle feeding industry, which derived much of its impetus for growth and development from nearby sources of feed supplies and feeder cattle, has mushroomed into a major cattle feeding center with highly mechanized and large commercial, factory-type feedlots. Results from this study suggest that large commercial feedlots may increase even more in size and number within the Southern Plains during the next decade. This is especially true for the Rolling Plains and Panhandle areas of Texas and Oklahoma.

Additional increases in number and size of large commercial feedlots in the Southern Plains raise questions concerning the adequacy of future feed resources and feeder cattle supplies as well as market outlets for fed beef. Current and potential supplies of grain sorghum are of prime importance under current feeding programs employed by the Southern Plains feedlots. One of the major factors presently governing the supply and production of grain sorghum is the amount of irrigation water available in the future in the Texas and Oklahoma Panhandle and Plains areas. Current research measuring the economic life of irrigation water in a specified area south of the Canadian River in Texas indicates that a substantial decline can be anticipated in that area during the next decade.[16] However, this decline is expected to be partially offset by irrigation developments north of the Canadian River during the same period. In the absence of the development of new grain sorghum varieties especially adapted to dryland growing conditions or other technological developments, grain sorghum production may decline from current levels in the Panhandle and Plains areas by 1980. However, the implementation of a recent massive 50-year Water Plan, proposed by the Texas Water Development Board, would make it possible to greatly expand grain and forage production in the future.[17] Other possibilities include expanded grain sorghum production in the Texas Coastal Plains area which is well suited for such production.

The Southern Plains, nevertheless, possess abundant resources for substantial increases in cattle feeding above current levels. During 1966-67, Texas produced about 45 percent of the total U. S. grain sorghum production. Oklahoma production accounted for another 3 percent. Beef cows 2 years and older in Texas and Oklahoma annually account for more than 20 percent of the U. S. January 1 inventory. Table 25 provides estimates of the maximum number of cattle that could have been fed in Texas during 1966-67 from Texas produced grain under various assumptions regarding exports and consumption. When allowances are made for carryover, poultry and other livestock and domestic non-feed use with no allowances for exports, the maximum number of cattle that could have been fed was 7.6 million head. These assumptions, however, are not too realistic since Texas is a major exporter of surplus grain sorghum. Data are not available on the proportion of Texas production exported, but total U. S. exports represented approximately 28 percent of the U. S. production during

[16] Hughes, W. F. and W. L. Harmon, Projected Economic Life of Water Resources, Subdivision No. 1, High Plains Underground Water Reservoir, Texas Agr. Exp. Sta. and FPED, ERS, USDA (in process).

[17] *Texas Water Plan Summary*, Texas Water Development Board, Austin, Texas, November 1968.

Table 25. Estimated maximum number of cattle that could be fed in Texas, given 1966-67 grain sorghum production and specified assumptions regarding domestic consumption and exports

Item	Exports as a Percent of Texas Production (1966-67)			
	0	15	25	35
	1,000 bushels			
Average Texas Production (1966-67)	327,590	327,590	327,590	327,590
Production not available for cattle feeding:				
Exports1/	0	49,138	81,898	114,656
Domestic non-feed use2/	5,962	5,962	5,962	5,962
Consumption by the Texas poultry-turkey, dairy, hog, and sheep and lamb feeding industry3/	55,513	55,513	55,513	55,513
Carryover4/	16,380	16,380	16,380	16,380
Total	77,855	126,993	159,753	192,511
Available for cattle feeding	249,735	200,597	167,837	135,079
Cattle feeding potential given grain sorghum consumption per head:	1,000 head			
1830 pounds (120 days @ 15lbs/day)	7,770	6,241	5,222	4,202
2015 pounds (130 days @ 15.5lbs/day)	6,941	5,575	4,664	3,754
2240 pounds (140 days @ 16lbs/day)	6,243	5,015	4,196	3,377
2475 pounds (150 days @ 16.5lbs/day)	5,651	4,539	3,798	3,056

Source: Feed Situation, FdS-226, ERS, USDA, November 1968 and Texas Crop and Livestock Reporting Service, Statistical Reporting Service, USDA, Austin, Texas.

1/U.S. exports were equal to 27.95 percent of the 1966-67 U.S. production.
2/U.S. domestic non-feed use was equal to 1.82 percent of the 1966-67 production.
3/Estimated by Extension Specialist in the Poultry Science and Animal Science Departments, Texas A&M University.
4/Assumes a carryover equal to 5 percent of annual production.

1966-67. Given the assumption that 15 percent of the Texas grain sorghum production is exported, and all other feed uses are held constant at the 1966-67 levels, surplus grain sorghum available from Texas production would have been sufficient for feeding 5-6 million head. If 25 percent of the Texas production had been exported and other feed uses held constant, 4-5 million head of cattle could have been fed from the available supplies of surplus grain sorghum in 1966-67.

Grain sorghum production in Oklahoma during 1966-67 was about balanced with the number of fed cattle marketed from feedlots in that state. Feedlots in the Oklahoma Panhandle and Western Oklahoma, however, are generally in a favorable position to import grain sorghum since they are located adjacent to the two major grain sorghum production areas in the U. S. While Texas is the leading grain sorghum producing state, Kansas, the second ranking state, annually accounts for about one-fifth of the U. S. grain sorghum production. In addition, Oklahoma feedlots are also able to draw upon the relatively large supplies of barley and wheat produced annually in Oklahoma.

Recent studies have indicated that Texas and Oklahoma possess a locational advantage over other surplus fed beef producing areas for shipping fed beef and live fed cattle to the deficit Southeastern states.[18]

[18]Williams, W. F. and R. A. Dietrich, An Interregional Analysis of the Fed Beef Economy, AER 88, USDA, April 1966.

The primary competitors of the Southern Plains for these markets are Kansas, Missouri and Colorado. Other large potential markets include the West Coast and the Northeast.

The future development and growth of the cattle feeding industry in the Southern Plains, however, is affected not only by the volume of locally produced feed and feeder cattle, the local population and income situation, but also by competition for markets and resource inputs from feedlot producers throughout the United States. Potential developments for the Southern Plains cattle feeding industry as suggested by this study include:

(1) The number and size of large feedlots, those with 10,000-head-and-over capacity, will continue to increase within the Southern Plains. Smaller feedlots will probably decrease in number and size and account for an increasingly smaller proportion of the cattle marketed from Southern Plains feedlots. Since this study indicates the existence of economies of size beyond the range of the available data, additional research may be desirable for determining optimum sizes of feedlots relative to given levels of technology for such discrete or indivisible items as milling equipment.

(2) Increased emphasis will be placed on a high degree of feedlot utilization rates as feedlots increase in size and are faced with increasingly larger capital investments in fixed facilities. Consequently, the proportion of cattle fed on a custom basis will probably increase above current levels. An economic analysis regarding the various types and kinds of custom feeding arrangements may become necessary as custom feeding continues to increase within the Southern Plains.

(3) The use of more refined management techniques and the adaptation of high speed computer programs may become essential for large commercial feedlots as an aid to management in making decisions regarding feeding practices as well as decisions relative to sources of feed and feeder cattle and market outlets.

(4) Contractual arrangements with feeder cattle producers may become necessary to insure adequate quantities and desired types of feeder cattle on a continuous basis as feeding facilities expand. Numbers of feeder cattle annually produced in Texas and Oklahoma greatly exceed the local feedlot requirements, but substantial numbers of feeder cattle are shipped into the Southern Plains from other states primarily to offset the seasonal nature of feeder cattle production in Texas and Oklahoma.

(5) To insure orderly growth and expansion within the cattle feeding industry, and also to expedite decision making, it may become necessary to project supplies of future feeder cattle, on a regional basis, given realistic assumptions relative to existing resource bases available for producing feeder cattle.

In addition, projection of feed grain and forage supplies under alternative assumptions regarding water use and government programs and projected demand levels for fed beef on a national and regional basis may also be desirable for determining optimum feeding levels.

(6) Based on feeding cost differentials between feeding areas and available sources of nearby feed supplies, cattle feeding will continue to be concentrated most heavily in the Texas and Oklahoma Panhandle areas of the Southern Plains. Optimum location of cattle feeding facilities and slaughtering firms will continue to be important considerations for firms seeking entry into the feeding and slaughtering industry.

(7) Contractual arrangement between the feedlots and packers may also be desirable to expedite decision making and the flow patterns of cattle into and out of feedlots.

(8) Additional areas requiring consideration include feeder cattle buying practices, selling arrangements for finished cattle, source and type of financing and the economic feasibility of conducting preconditioning and warmup feeding operations. These were discussed in a previous publication.[19]

Results from this study suggest that considerable potential exists for continued growth and expansion of the cattle feeding industry within the Southern Plains. However, the future growth will be dependent upon the availability of the necessary resource inputs, the ability to compete for markets with other regions and industries and the availability of adequate information for intelligent decision making. Realization of goals and opportunities in the cattle feeding, as well as in other segments of the livestock and meat industry, is dependent upon management-organization ingenuity among the various types of firms within the livestock and meat economy and the ability of institutions and public agencies to assist these firms in realizing maximum advantages from future opportunities.

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[19]Dietrich, R. A., The Texas-Oklahoma Cattle Feeding Industry–Structure and Operational Characteristics, Texas Agr. Exp. Sta. Bull. 1079, December 1968.

APPENDIX A

Supplementary Tables

Appendix A--Table 1. Fixed investment per head of capacity, by major item of equipment and feeding area, Texas feedlots, 1966-67

Item	Feeding area				
	Panhandle-Plains	Plateau-Pecos	East Texas	Gulf Coast and Rio Grande Plains	Total
	Dollars				
Pens and equipment	10.78	7.91	11.83	11.14	10.72
Water system	2.42	2.23	1.84	1.65	2.20
Milling equipment	9.02	6.84	7.94	7.55	8.46
Feed storage facilities and equipment	4.93	3.68	4.31	10.20	5.81
Feed distribution equipment	2.12	2.19	1.64	2.21	2.10
Manure equipment	.47	.76	.14	.98	.56
Transportation equipment	1.28	1.50	.73	1.88	1.36
Land	2.61	.85	1.83	3.01	2.47
Office and office equipment	.84	.56	.39	.66	.74
Scales and scale house	.84	1.06	.55	1.07	.88
Total	35.31	27.58	31.20	40.35	35.29

Appendix A--Table 2. Fixed investments per head of capacity, by major item of equipment and feeding area, Oklahoma feedlots, 1966-67

Item	Feeding area				
	Panhandle	Northern Oklahoma	Southeastern and Central Oklahoma	Southwestern Oklahoma	Total
	Dollars				
Pens and equipment	11.30	11.50	10.47	11.73	11.25
Water system	2.65	2.07	1.72	1.53	2.20
Milling equipment	5.89	1.78	14.32	12.59	8.16
Feed storage facilities and equipment	5.31	2.63	6.76	3.78	4.98
Feed distribution equipment	3.78	3.32	2.72	3.16	3.41
Manure equipment	1.07	.77	1.54	1/	.92
Transportation equipment	1.59	1.35	1.61	1.47	1.54
Land	.76	1.59	2.77	1.07	1.29
Office and office equipment	1.01	.10	.68	.59	.77
Scales and scale house	1.12	1.00	1.81	1.25	1.25
Total	34.48	26.11	44.40	37.17	35.77

1/ None reported by respondents interviewed.

Appendix A--Table 3. Annual depreciation costs per head of capacity, by major items of equipment and size of feedlot, Texas feedlots, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Pens and equipment	.4143	.6145	.8712	.5694	.5585	.6074
Water system	.1406	.1553	.1245	.0927	.1376	.1288
Milling equipment	.3356	.6476	.7432	.6922	.7314	.7185
Feed storage facilities and equipment	.6642	.4904	.3512	.1107	.2149	.2325
Feed distribution equipment	.9025	.6551	.5595	.3469	.2935	.3613
Manure equipment	.0804	.2817	.1871	.0719	.0586	.0859
Transportation equipment	.4111	.5906	.2386	.1628	.1243	.1633
Office and office equipment	.0107	.0347	.0434	.0578	.0383	.0417
Scales and scale house	.0409	.0964	.0691	.0565	.0290	.0414
Total	3.0003	3.5663	3.1878	2.1609	2.1861	2.3808

Appendix A--Table 4. Annual depreciation costs per head of capacity, by major item of equipment and size of feedlot, Oklahoma feedlots, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Pens and equipment	.3412	.7854	.5246	.6633	.6517	.6376
Water system	.0956	.1459	.0896	.1072	.1507	.1292
Milling equipment	.1106	.3112	.6860	.2566	.9562	.6939
Feed storage facilities and equipment	.3137	.4225	.2525	.1057	.1903	.1993
Feed distribution equipment	.6969	.6170	.7263	.4998	.5733	.5874
Manure equipment	.1437	.1150	.0271	.2372	.1405	.1416
Transportation equipment	.6512	.2805	.3455	.2137	.0940	.1849
Office and office equipment	.0037	.0092	.0607	.0455	.0425	.0435
Scales and scale house	.0031	.0715	.0636	.0882	.0448	.0592
Total	2.3597	2.7582	2.7759	2.2172	2.8440	2.6766

Appendix A--Table 5. Annual fixed costs per pound of gain, by feeding area, Texas feedlots, 1966-67

Item	Feeding area				
	Panhandle-Plains	Plateau-Pecos	East Texas	Gulf Coast and Rio Grande Plains	Total
	Dollars				
Depreciation	.0033	.0041	.0033	.0048	.0036
Interest	.0018	.0019	.0018	.0027	.0019
Taxes	.0004	.0005	.0004	.0006	.0005
Insurance	.0003	.0004	.0003	.0005	.0003
Repairs	.0016	.0025	.0013	.0029	.0018
Labor	.0031	.0045	.0029	.0063	.0037
Total	.0105	.0139	.0100	.0178	.0118

Appendix A--Table 6. Annual fixed costs per pound of gain, by feeding area, Oklahoma feedlots, 1966-67

Item	Feeding area				
	Panhandle	Northern Oklahoma	Southeastern and Central Oklahoma	Southwestern Oklahoma	Total
	Dollars				
Depreciation	.0037	.0045	.0064	.0050	.0044
Interest	.0017	.0022	.0024	.0023	.0021
Taxes	.0005	.0006	.0009	.0007	.0006
Insurance	.0004	.0003	.0008	.0005	.0005
Repairs	.0030	.0011	.0026	.0027	.0027
Labor	.0037	.0069	.0042	.0059	.0044
Total	.0130	.0156	.0173	.0171	.0147

Appendix A--Table 7. Annual long term interest, per head of capacity, by major item of equipment and size of feedlot, Texas feedlots, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Pens & equipment	.2522	.3739	.5304	.3467	.3400	.3698
Water system	.0804	.0890	.0713	.0531	.0788	.0738
Milling equipment	.1363	.2628	.3016	.2809	.2969	.2916
Feed storage facilities & equipment	.5978	.4414	.3161	.0996	.1934	.2093
Feed distribution equipment	.1792	.1302	.1112	.0690	.0584	.0718
Manure equipment	.0169	.0594	.0395	.0152	.0124	.0181
Transportation equipment	.1191	.1712	.0692	.0472	.0361	.0474
Land	.1682	.1878	.1865	.1827	.1289	.1484
Office & office equipment	.0064	.0210	.0264	.0352	.0233	.0254
Scales & scale house	.0298	.0704	.0505	.0413	.0212	.0302
Total	1.5863	1.8071	1.7027	1.1709	1.1894	1.2858

Appendix A--Table 8. Annual long term interest cost, per head of capacity, by major item of equipment and size of feedlot, Oklahoma feedlots, 1966-67

Item	Less than 1,000 head capacity	1,000 to 1,999 head capacity	2,000 to 4,999 head capacity	5,000 to 9,999 head capacity	10,000 head and over capacity	Total
	Dollars					
Pens & equipment	.2062	.4779	.3193	.4038	.3967	.3881
Water system	.0550	.0836	.0513	.0614	.0863	.0740
Milling equipment	.0456	.1262	.2784	.1041	.3881	.2816
Feed storage facilities & equipment	.2825	.3802	.2273	.0951	.1713	.1794
Feed distribution equipment	.1381	.1226	.1449	.0994	.1140	.1168
Manure equipment	.0300	.0242	.0058	.0502	.0297	.0299
Transportation equipment	.1881	.0812	.1002	.0620	.0272	.0536
Land	.3094	.2242	.0670	.0550	.0645	.0772
Office & office equipment	.0019	.0055	.0369	.0277	.0259	.0264
Scales & scale house	.0019	.0520	.0465	.0644	.0328	.0432
Total	1.2587	1.5776	1.2776	1.0231	1.3365	1.2702

Appendix A--Table 9. Variable costs per pound of gain, by feeding area, Texas feedlots, 1966-67

Item	Feeding area				
	Panhandle-Plains	Plateau-Pecos	East Texas	Gulf Coast and Rio Grande Plains	Total
	Dollars				
Feed	.1781	.1687	.1958	.1680	.1775
Labor 1/	.0082	.0075	.0059	.0084	.0080
Interest:					
Feed	.0052	.0050	.0057	.0049	.0052
Feeder cattle	.0120	.0105	.0151	.0110	.0120
Labor	.0002	.0002	.0002	.0002	.0002
Other 2/	.0002	.0003	.0002	.0002	.0002
Death loss	.0049	.0081	.0028	.0063	.0052
Veterinarian and medication	.0045	.0042	.0041	.0053	.0046
Gas and oil	.0011	.0007	.0016	.0012	.0011
Electricity	.0010	.0012	.0008	.0009	.0010
Telephone and communications	.0004	.0003	.0002	.0004	.0004
Other 3/	.0011	.0024	.0007	.0005	.0010
Total	.2167	.2091	.2331	.2073	.2164

1/ Includes assessments for Social Security and Workman's Compensation.

2/ Interest charges for operating capital for five months. This does not include interest charges for feed, cattle and labor.

3/ Includes charges for office supplies, consultant fees, liability insurance, taxes on cattle, and miscellaneous expenditures.

Appendix A--Table 10. Variable costs per pound of gain, by feeding area, Oklahoma feedlots, 1966-67

Item	Feeding area				
	Panhandle	Northern Oklahoma	Southeastern and Central Oklahoma	Southwestern Oklahoma	Total
	Dollars				
Feed	.1833	.2006	.1944	.1891	.1873
Labor 1/	.0092	.0113	.0141	.0121	.0106
Interest:					
Feed	.0054	.0059	.0057	.0055	.0055
Feeder cattle	.0125	.0154	.0182	.0164	.0151
Labor	.0003	.0003	.0004	.0004	.0003
Other 2/	.0002	.0002	.0002	.0003	.0002
Death loss	.0049	.0102	.0114	.0064	.0066
Veterinarian and medication	.0036	.0035	.0036	.0046	.0038
Gas and oil	.0011	.0016	.0020	.0015	.0013
Electricity	.0011	.0005	.0015	.0012	.0011
Telephone and communications	.0006	.0006	.0005	.0005	.0005
Other 3/	.0005	.0004	.0003	.0010	.0005
Total	.2227	.2505	.2523	.2390	.2328

1/ Includes assessments for Social Security and Workman's Compensation.

2/ Interest charges for operating capital for five months. This does not include interest charges for feed, cattle and labor.

3/ Includes charges for office supplies, consultant fees, liability insurance, taxes on cattle, and miscellaneous expenditures.

Appendix A--Table 11. Total feeding costs per pound of gain, by type of cost and feeding area, Texas feedlots, 1966-67

Type of cost	Feeding area				
	Panhandle-Plains	Plateau-Pecos	East Texas	Gulf Coast and Rio Grande Plains	Total
	Dollars				
Fixed	.0105	.0139	.0100	.0178	.0118
Variable	.2167	.2091	.2331	.2073	.2164
Total	.2272	.2230	.2431	.2251	.2282

Appendix A--Table 12. Total feeding costs per pound of gain, by type of cost and feeding area, Oklahoma feedlots, 1966-67

Type of cost	Feeding area				
	Panhandle	Northern Oklahoma	Southeastern and Central Oklahoma	Southwestern Oklahoma	Total
	Dollars				
Fixed	.0130	.0156	.0173	.0171	.0167
Variable	.2227	.2505	.2523	.2390	.2393
Total	.2357	.2661	.2696	.2561	.2560

APPENDIX B

Procedure for Estimating Depreciation Costs and Classification of Feedlot Labor

Depreciation Costs

The expected life and salvage value, by major items of equipment, were established after consultation with feedlot operators as:

Item	Expected life (years)	Salvage value (percent of original cost)
Pens and equipment	15	15
Water system	15	12
Milling equipment	10	15
Feed storage	20	20
Feed distribution	5	14
Manure equipment	6	8
Transportaion equipment	7	16
Office and equipment	15	15
Scale and scale house	18	15

Depreciation cost was estimated as:

$$\text{Depreciation cost} = \frac{\text{Original Cost} - \text{Salvage Value}}{\text{Expected Life}}$$

Classification of Feedlot Labor

Labor was classified as fixed or variable, by size of feedlot, as:

10,000-head-and-over Capacity

Fixed: Operator; yard foreman; office manager

Variable: All other labor

5,000 - 9,999-head Capacity

Fixed: Operator; one half of yard foreman or total yard foreman where an operator is not employed; office manager or one clerk where an office manager is not employed

Variable: All other labor

2,000 - 4,999-head Capacity

Fixed: Operator or yard foreman where an operator is not employed; office manager or one clerk where an office manager is not employed

Variable: All other labor

1,999-head-and-under Capacity

Fixed: One half of operator or one half of yard foreman where an operator is not employed

Variable: All other labor

In additon, Social Security and Workmen's Compensation were also computed according to job classification as:

Social Security = .034 × Annual Labor Cost
(no assessments in excess of $6,600 annual salary)

Workmen's Compensation =
.0593 × Annual Labor Cost
(no assessments in excess of $10,400 annual salary)

APPENDIX C

Derivation of Cost Curves

Four statistical models were postulated for deriving average cost curves. These models were:

$$Y_i = A + b_1X_1 \qquad \text{(Model 1)}$$

$$Y_i = A + b_1X_1 + b_2(X_1)^2 \qquad \text{(Model 2)}$$

$$Y_i = A + b_1\,(1/X_1) \qquad \text{(Model 3)}$$

$$\log Y_i = A + b_1 \log X_1 \qquad \text{(Model 4)}$$

where Y_i is cost per pound of gain in dollars for the *ith* or specified cost item and X_1 is the one-time capacity of individual feedlots.

Model 1—assumes a constant or linear relationship between cost per unit of output and size of feedlot.

Model 2—assumes that costs decrease as the size of feedlots increase but that diseconomies set in within the range of the available data and that costs per unit of output increase.

Model 3—assumes that costs per unit of output decrease rather sharply and then tend to flatten out as the size of feedlots is increased.

Model 4—assumes that costs per unit of output decrease at a slower rate than those of Model 3 but that costs per unit of output tend to decrease as the size of feedlots is increased. This model assumes, essentially, that average costs have not increased as a result of successively larger feedlots in the feeding industry.

According to statistical tests, the coefficient of determination (R^2), the F-test and the t-test, Model 4 or the log function tended to fit the data better in almost all cases than did the other models employed in this study. However, Models 1, 2 and 3 were also generally statistically significant for most of the functions developed in this study.

Cost functions showing the relationship of feedlot size to total fixed cost and various items of fixed cost for the cattle feeding industry in Texas and Oklahoma are:

$$\text{Log } Y_1 = -.932490 - .231240 \underset{(10.32)**}{\log X} \quad (1)$$
$$R^2 = .47 \qquad F = 106.46**$$
$$MSD = .201780 \qquad SE = .449199$$

$$\text{Log } Y_2 = -1.498066 - .224465 \underset{(9.02)**}{\log X} \quad (2)$$
$$R^2 = .41 \qquad F = 81.44**$$
$$MSD = .223941 \qquad SE = .473224$$

$$\text{Log } Y_3 = -1.640362 - .262971 \underset{(10.52)**}{\log X} \quad (3)$$
$$R^2 = .48 \qquad F = 110.64**$$
$$MSD = .225097 \qquad SE = .474444$$

$$\text{Log } Y_4 = -2.286326 - .254187 \underset{(10.11)**}{\log X} \quad (4)$$
$$R^2 = .46 \qquad F = 102.21**$$
$$MSD = .226373 \qquad SE = .475787$$

$$\text{Log } Y_5 = -2.586028 - .207156 \underset{(6.30)**}{\log X} \quad (5)$$
$$R^2 = .25 \qquad F = 39.70**$$
$$MSD = .296034 \qquad SE = .544090$$

$$\text{Log } Y_6 = -1.457329 - .223382 \underset{(6.32)**}{\log X} \quad (6)$$
$$R^2 = .25 \qquad F = 39.92**$$
$$MSD = .318312 \qquad SE = .564191$$

$$\text{Log } Y_7 = -2.470576 - .074890 \underset{(1.67)}{\log X} \quad (7)$$
$$R^2 = .02 \qquad F = 2.80$$
$$MSD = .385712 \qquad SE = .621057$$

where:

Y_1 = total annual fixed costs per pound of gain in dollars,

Y_2 = annual depreciation cost per pound of gain in dollars,

Y_3 = annual interest cost per pound of gain in dollars,

Y_4 = annual taxes per pound of gain in dollars,

Y_5 = annual insurance cost per pound of gain in dollars,

Y_6 = annual fixed labor cost per pound of gain in dollars,

Y_7 = annual repair cost per pound of gain in dollars.

X = feedlot size or one-time capacity.

R^2 = Coefficient of determination.

F = F-test.

MSD = mean squared deviation.

SE = standard error of estimate.

** and * = statistical significance at the 1-percent and 5-percent level, respectively.

The t-value of the estimated parameter is directly below each coefficient.

The analysis of variance associated with the regression of feedlot size and fixed cost is shown in Table 1.

Cost functions depicting the relationship of feedlot size and utilization rate to various items of fixed costs and total costs for feedlots with 1,000-head-and-over capacity in Texas and Oklahoma are:

$$\text{Log } Y_1 = -1.118793 - .218175 \underset{(4.85)**}{\log X_1} - .597284 \underset{(6.46)**}{\log X_2} \quad (8)$$
$$R^2 = .61 \qquad F = 63.80**$$
$$MSD = .147404 \qquad SE = .383932$$

$$\text{Log } Y_2 = -1.586731 - .232509 \underset{(4.41)**}{\log X_1} - .520131 \underset{(4.80)**}{\log X_2} \quad (9)$$
$$R^2 = .51 \qquad F = 42.07**$$
$$MSD = .172694 \qquad SE = .415565$$

Appendix C--Table 1. Analysis of variance associated with the regression of feedlot size on total fixed costs and individual fixed cost items for total feedlots, Texas and Oklahoma, 1966-67

Item and Source	df	Sum of squares	Mean square	F
Total Fixed Costs:				
Total	120	9.179733		
Due to regression	1	4.334646	4.334646	106.46**
Error	119	4.845087	.040715	
Annual Depreciation Costs:				
Total	120	10.052193		
Due to regression	1	4.084379	4.084379	81.44**
Error	119	5.967814	.050150	
Annual Interest Costs:				
Total	120	11.635462		
Due to regression	1	5.605878	5.605878	110.64**
Error	119	6.029584	.050669	
Annual Insurance Costs:				
Total	120	13.907439		
Due to regression	1	3.478765	3.478765	39.70**
Error	119	10.428674	.087636	
Annual Taxes:				
Total	120	11.335743		
Due to regression	1	5.237612	5.237612	102.21**
Error	119	6.098131	.051245	
Annual Fixed Labor Costs:				
Total	120	16.102416		
Due to regression	1	4.045050	4.045050	39.92**
Error	119	12.057366	.101322	
Annual Repairs:				
Total	114	17.228730		
Due to regression	1	.417300	.417300	2.80
Error	113	16.811430	.148774	

** and * denotes significance at the 1 percent and 5 percent levels, respectively.

$$\text{Log } Y_3 = -1.824769 - .241275 \log X_1 - .466161 \log X_2 \quad (10)$$
$$(4.44)^{**} \qquad (4.17)^{**}$$
$$R^2 = .48 \qquad F = 36.74^{**}$$
$$MSD = .178117 \qquad SE = .422039$$

$$\text{Log } Y_4 = -2.421412 - .246934 \log X_1 - .487843 \log X_2 \quad (11)$$
$$(4.58)^{**} \qquad (4.40)^{**}$$
$$R^2 = .50 \qquad F = 40.06^{**}$$
$$MSD = .176472 \qquad SE = .420086$$

$$\text{Log } Y_5 = -2.713823 - .206789 \log X_1 - .508604 \log X_2 \quad (12)$$
$$(2.69)^{**} \qquad (3.22)^{**}$$
$$R^2 = .30 \qquad F = 17.37^{**}$$
$$MSD = .251726 \qquad SE = .501723$$

$$\text{Log } Y_6 = -1.804095 - .177299 \log X_1 - .746747 \log X_2 \quad (13)$$
$$(2.19)^{*} \qquad (4.49)^{**}$$
$$R^2 = .37 \qquad F = 23.01^{**}$$
$$MSD = .265030 \qquad SE = .514811$$

where:

X_1 = feedlot size or one-time capacity.

X_2 = feedlot utilization rate and other variables were previously identified.

The analysis of variance associated with the regression of these models is shown in Table 2.

Appendix C--Table 2. Analysis of variance associated with the regression of feedlot size and feedlot utilization rate on total fixed costs and individual fixed costs items for feedlots with 1,000 head and over capacity, Texas and Oklahoma, 1966-67 1/

Item and Source	df	Sum of squares	Mean square	F
Total Fixed Costs:				
Total	82	4.510541		
Due to feedlot size (b_1/b_0)	1	1.124138	1.124138	51.74**
Due to utilization rate (b_2/b_0, b_1)	1	1.648159	1.648159	75.85**
Error	80	1.738244	.021728	
Annual Depreciation Costs:				
Total	82	4.895433		
Due to feedlot size (b_1/b_0)	1	1.183823	1.183823	39.69**
Due to utilization rate (b_2/b_0, b_1)	1	1.325763	1.325763	44.45**
Error	80	2.385847	.029823	
Annual Interest Costs:				
Total	82	4.869419		
Due to feedlot size (b_1/b_0)	1	1.213834	1.213834	38.26**
Due to utilization rate (b_2/b_0, b_1)	1	1.117533	1.117533	35.22**
Error	80	2.538052	.031726	
Annual Insurance Costs:				
Total	82	7.270076		
Due to feedlot size (b_1/b_0)	1	.969055	.969055	15.29**
Due to utilization rate (b_2/b_0, b_1)	1	1.231751	1.231751	19.44**
Error	80	5.069270	.063366	
Annual Taxes:				
Total	82	4.986536		
Due to feedlot size (b_1/b_0)	1	1.280551	1.280551	41.12**
Due to utilization rate (b_2/b_0, b_1)	1	1.214593	1.214593	39.00**
Error	80	2.491392	.031142	
Annual Fixed Labor Costs:				
Total	82	8.852236		
Due to feedlot size (b_1/b_0)	1	.901417	.901417	12.83**
Due to utilization rate (b_2/b_0, b_1)	1	2.331541	2.331541	33.19**
Error	80	5.619278	.070241	

1/ The regression model for annual repairs was not significant and also contained a wrong sign. Annual repairs are included in the model for total annual fixed costs.

** Denotes significance at the 1-percent level.

The equation measuring the relationship between feedlot size and total feeding cost is:

$$\text{Log } Y_8 = -.499194 - .030374 \log X_1 \quad (14)$$
$$(3.72)^{**}$$
$$R^2 = .10 \qquad F = 13.87^{**}$$
$$MSD = .073468 \qquad SE = .271050$$

where:

Y_8 = total feeding costs; the other variable was previously identified.